Race, Identity, and Resilience:

Black College Students Negotiating Success in Mathematics and Engineering

BY

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THESIS

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This thesis is dedicated to the nine-year-old that exclaimed, "Mommy, you make my heart bloom!" May your heart continue to blossom, always.

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LIST OF ABBREVIATIONS

ACT	Scholastic Aptitude Test
BSU	Black Student Union
CRT	Critical Race Theory
GPA	Grade Point Average
HBCU	Historically Black College or University
MBA	Master of Business Administration
MIBI	Multidimensional Inventory of Black Identity
MMRI	Multidimensional Model of Racial Identity
NAACP	National Association for the Advancement of Colored People
NSBE	National Society of Black Engineers
NVB	Not Visibly Black
PVEST	Phenomenological Variant of Ecological Systems Theory
RIAS	Racial Identity Attitudes Scale
SES	Socioeconomic Status
STEM	Science, Technology, Engineering and Mathematics
TA	Teaching Assistant

SUMMARY

This study analyzes the experiences of 23 high-achieving Black mathematics and engineering junior, senior and graduate-level college students. Counter-narrative and case study methods were used to explore and analyze the students' racial and mathematical identities as a window into the factors that accounted for their resilience. Additionally, the Multidimensional Inventory of Black Identity (MIBI) was administered to complement the exploration of the respondents' emerging identities of being Black, particularly in academic arenas where their presence is scarce. As cross-case analysis was performed on all 23 students, this study further dissects the experiences of 3 students using the life-story interview approach. The three students were chosen specifically because of the great variance in their recognition (or lack thereof) of how race, class, gender, and other social determinants operated to constrain (or not) the life chances of people like themselves.

Results reveal two main motivations for, and trajectories of, resilience: (1) achieving to prove racial stereotypes wrong, and (2) achieving to serve as role models for Black learners. A model of these two overlapping and developmental trajectories is presented. The model differentiates two forms of resilience, fragile and robust, and has implications for further studies that integrate considerations of identity formation processes and the racialized nature of students' mathematical and life experiences. This model proposes the integration of identity processes and mathematical experiences in understanding the mathematical outcomes of Black college students.

CHAPTER 1

THE PROBLEM AND ITS BACKGROUND

> The world of math: it is competitive; it is brutal. There is a racial hierarchy in this country [which] exists, a caste system, and when it comes to [the] smarts department—especially in mathematics—we [Black Americans] are on the bottom. That's it. I mean, that's it. Fortunately, I have a good sense of humor; otherwise, I think I'd go crazy.
>
> *– Rob, 40-year-old, high-achieving Black mathematics doctoral candidate*

The excerpt presented above comes from an interview with one of the participants in this dissertation study, which I designed to explore the voices and experiences of a select group of academically successful Black college students majoring in mathematics and engineering. At the time of his initial interview, Rob was a doctoral candidate in applied mathematics, attending an urban university in the Midwest. By the time of his second interview, Rob had received his PhD and accepted a tenure-track position at a predominately African American university. Rob was one of only a few Black Americans to receive a PhD in applied mathematics in 2007. Of the 1,116 doctorates awarded by U.S. mathematics departments in the 2004–2005 academic year, 434 (39%) of them went to U. S. citizens, leaving the majority of doctorates awarded to foreign nationals (Mooney & Neelakantan, 2006). Of those 434 American recipients, only 14 were Black (Mooney & Neelakantan, 2006).

Rob's quote, and my experiences with other successful Black mathematics and engineering students, indicates that some Black students must negotiate a delicate balance in their lives. For me, analysis of the above excerpt, its the life narrative context, and the narratives of the other participants in my dissertation, raised important considerations regarding mathematics learning and participation among Blacks; considerations not usually raised in current math education research on Black students. These considerations include race-conscious self-

perceptions in the journey toward completing a degree in mathematics and engineering; definitions of group membership, including societal and self-constructions of what it means to "be Black" in the contexts of mathematics and engineering participation, and what it means to persist in contexts where Black students are few in number and where negative societal beliefs about their ability and motivation endure. Rarely do we hear about successful students like Rob and the other twenty-two participants in this dissertation. Less often do we hear them talk about and frame their experiences *as Blacks* in the contexts of mathematics and engineering.

Statement of the Problem and Research Questions

Recent research in mathematics and science education has begun to raise the concern that failure and limited persistence among Black students continues to be constructed as normative (Atwater, 2000; Brown, 2004; Johnson, 1984; Ladson-Billing & Tate 1995; Lubienski, 2001a, 2001b, 2002b; Martin, 2000, 2005; Moses-Snipes & Snipes, 2005; Oakes, 1995; Ortiz & Calabrese Barton, 2003; Reyes & Stanic, 1988; Tate, 1997). One reason for this is that mathematics achievement, for example, is typically evaluated using aggregated test score data, which often provide a very limited and narrow perspective on mathematics learning. Further, most studies of mathematics achievement have failed to address within-group variations among Black students, ignoring the fact that, despite challenging experiences, many Black students exhibit positive agency and achieve mathematics and engineering success on tests as well as along a number of dimensions not captured in test score data (Berry, 2003; Martin, 2000, 2006a, 2006b, Moody, 2001, 2003).

Even in the context of well-known intervention programs that increase the participation of Black students (e.g., University of California at Berkeley's Mathematics Workshop Program, The Meyerhoff Scholars Program, The Algebra Project) little is known about what happens at

the individual student level or, by way of comparison, about Black students who succeed in mathematics and engineering without the benefit of a structured program (Hrabowski & Maton, 1995). Moreover, seemingly absent from the larger discourse on achievement and persistence outcomes are the voices of Black mathematics learners, themselves, particularly those who have successfully negotiated the mathematics and engineering pipeline. Considering the preponderance of research highlighting Black failure, there is a significant gap in understanding success among Black students in the academically competitive, and socially valued, areas of mathematics and engineering (Gutierrez, 2000; Martin, 2006a, 2006b; Moody, 2003; Nasir, 2002; Stinson, 2004; Tate, 2005a, 2005b). My dissertation research addresses these issues and offers explanations for the success of Black students in these academic contexts.

This discussion speaks to the general question: "How do a select group of Black mathematics and engineering college students develop success-oriented belief systems and identities and interpret, frame, and maintain high achievement outcomes?" Ultimately, the objective of my dissertation research was to help me better understand, through their *first-person* accounts, how a select group of Black mathematics and engineering college students, like Rob, as well as those I have encountered in my other experiences, maintain, interpret, and frame high academic achievement and success within educational arenas where Black presence is scarce.

Qualitative research in the form of in-depth interviews and case study analysis has previously explored these considerations (Delgado, 1995; Denzin, 1994; Parker, 1998). Using counter-narratives (Bell, 1980, 1995, 2004; Delgado, 2000) and case study methods (Stake, 2000; Yin, 1994, 2003), I conducted interviews with 23 high-achieving Black mathematics and engineering juniors, seniors, and graduate students from Browning University (5), Soho University (4), Medium University (8), and Ivy University (6).

I conducted initial, in-depth interviews with all participants and followed up with second interviews of six participants. At the time the initial interviews were scheduled, per my request, the students also brought documents that spoke to their mathematics and engineering experiences and success. The documents included old report cards, awards for mathematics or engineering achievements, and scholarships based on mathematics or engineering achievements. Descriptive statistics were collected on participants from an analysis of demographic data and the Multidimensional Inventory of Black Identity (MIBI), a quantitative measure of Black racial identity.

Medium University and Browning University are public institutions located in large urban cities in the Midwest that serve the local populations. Soho University, although located on the south side of a large urban Midwest city, houses a large international population and caters to Science, Technology, Engineering and Mathematics (STEM) students. Ivy University, a private institution, is located in a Midwestern affluent suburb and attracts an international and middle to upper class student population due to its academic reputation and high tuition costs. Using the four institutions selected was valuable because their respective social contexts reflected differing pressures and supports that bear upon the students' identities as *Black* mathematics and engineering learners.

All participants self-identified as African American or Black, based on their voluntary response to my solicitation to participate in study. Although I use the term Black in this study to describe both U.S. born-Black Americans and non-U.S. born Blacks, I am cognizant of the nuances in racial identity that may occur for reasons that deal with nationality and culture. For example, a U.S.-born Black American student may have a vastly different racial identity than a Black student who was raised in Ghana and has recently come to the Untied States for educational reasons. Due to the large number of Black immigrants that major in mathematics

and engineering, both U.S.-born Black Americans and non-U.S. born Blacks were included in this study. The commonalities in their experiences, such as lack of privilege and power, are shared because of the shared meanings for *Blackness* in U.S. society. As a result, some U.S. Blacks and non-U.S. Black mathematics and engineering majors have formed common identities based on their shared experiences in America.

My focus on college upper-class and graduate students who have successfully negotiated the mathematics and engineering pipeline is a good choice for several reasons. These adult students were able to offer greater insight into and reflection on their experiences; they reflected on their experiences at the elementary, middle school, high school levels, and collegiate levels, and challenged and contested conventional wisdom and explanations for Black student success and failure in mathematics education. The junior, senior, and graduate status of students served as an indicator that they had successfully negotiated many of academic, political, and social obstacles toward obtaining a college degree in mathematics or engineering.

Collectively, Blacks have been socially constructed and portrayed as inferior and incapable of high mathematics and engineering achievement. Within this context of social devaluing, Blacks' performance in mathematics and engineering has often replicated these low expectations for academic success (Strutchens & Silver, 2000). However, this is only part of the story of Blacks' experiences in schools (Perry, 2003). The focus of my research is academic success in Black students and not academic disappointment. Therefore, I chose specifically not to utilize lower achieving Blacks majoring in mathematics and engineering for this study. My spotlight on high achievement counters the limited perspectives that have helped maintain the structure of racism in mathematics and engineering.

In defining academic success in mathematics and engineering I utilize conventional, quantitative measures of academic achievement and persistence outcomes, such as grade point

average (U.S. Department of Education, 2002). However, my analysis of first-person data revealed a number of other psychosocial factors that expand the notion of success and resilience for Black students in these disciplines. Scholars who have studied the education of Black students, such as Ladson-Billings (1998, 1999), have associated academic "success" with culturally relevant teaching that has, as its primary aim, to allow for students of color to choose academic achievement without compromising their identification with their culture. Although teachers are primarily responsible for building a culturally relevant classroom environment, students can create or have access to out-of-school competencies that aid in maintaining their cultural integrity while achieving academic excellence (Ladson-Billings, 1997).

The questions initially guiding my dissertation study included the following:

(1) What strategies do high-achieving Black college students use to demonstrate their resilience in mathematics and engineering?;

(2) What personal meanings do these Black students assign to their resilience and success in college mathematics and engineering?;

(3) How do these successful students give meaning to and negotiate what it means to "be Black" in the context of studying mathematics and engineering?;

(4) What role, if any, does the construction and negotiation of an Black identity serve for students who are high-achievers in mathematics and engineering?; and

(5) To what extent do academically successful Black college students characterize and respond to learning and participation in mathematics and engineering as racialized forms of experience?

I initially focused on these questions because I believed they would provide insight into themes critical to the academic success of Black students such as: (a) *resilience* and how resilience is developed and framed by students, (b) perceptions of opportunities and

constraints in various mathematical and engineering-based contexts, (c) strategies used by the students to negotiate successful participation in mathematics and engineering, and (d) the salience of racism in the lives and the mathematical and engineering experiences of the students, including the ways in which these students interpret and respond to the socially constructed meanings for race (Berry, 2003, 2005; Martin, 2000 2006a, 2006b; Moody, 2001, 2003; Stinson, 2004; Tate, 1994, 1995a, 1995b).

Significance of the Study

Studying successful students is an approach based upon, and conducted in, the spirit of Blacks' historical struggle for academic achievement in spite of surmounting odds and obstacles (Anderson, 1988, 1995; Harding, 1981; Perry, 2003; Woodson, 1990). By analyzing the stories of successful Black college students and the larger narratives in which their experiences are embedded, my study advances important and understudied considerations regarding participation in mathematics learning among Blacks. This study takes a fresh at look how mathematics and engineering education can be strengthened by probing the factors that help Black mathematics and engineering students succeed. Additionally, I propose a better appreciation of what it means to be academically successful in contexts where Black students are few in number and where negative societal and school beliefs about their ability and motivation persist. The examination of these phenomena opens the door for more holistic portrayals and examinations of high-achieving Black students.

This study stresses the social construction of reality and utilizes an interpretive approach to the meanings that individuals give to their realities (Berger & Luckmann, 1966: Denzin, 1994; Denzin & Lincoln, 2000; Guba & Lincoln, 2005). My analysis gives more attention to race and racism than class and gender because race was the most salient characteristic in the majority of

the students' lives (Thomas, 2000; Twine & Warren, 2000; West, 1993). Of course this does not imply that race, class, and gender intersections are unimportant. However, more nuanced understandings of race—understandings that do not reinforce deficit explanations for disparities in achievement and schooling experiences—must be developed among mathematics educators if these intersections are to be seriously considered (Martin, in press). Other social identities such as sexual orientation, neighborhood affiliation, African immigrant status, and college climate of the four different universities were also implicated in the narratives of these high achieving Black college students.

The focus on Blacks was also appropriate for this study because, collectively, they are the least successful in mathematics and engineering, in terms of enrollment and persistence to graduation and traditional assessment of academic outcomes (Fullilove & Treisman, 1990; Johnson & Kritsonis, 2006; Strutchens & Silver, 2000; Tate, 1997). However, continued focus on failure tell us little about how and why some Black students achieve in these disciplines while others, with similar life conditions, fall behind or out of school altogether. Rarely do we hear about successful students and even less often do we hear these students talk about and frame their own experiences *as Blacks* in mathematics (Berry, 2003, 2005; Martin, 2000, 2006a, 2006b, 2007; Moody, 1998, 2001) and engineering.

My study attempts to provide a space for Black college students to contribute to this important dialogue in mathematics education *from their own perspectives* (Berry, 2005; Ladson-Billings, 1998; Malloy, 1997; Moody, 1998, 2001) and to provide a different picture of Black mathematics and engineering achievement. Significant to my study were the respondents' perceptions of how *being Black* and mathematics and engineering learners impacts their viewpoints, their peer relationships, and their less than optimistic perspective on being future Black mathematics and engineering professionals. The high-achieving students presented in this

study can provide genuine examples for other Black students, who are often at risk of being placed out of mathematics before they even step inside a mathematics classroom (Stiff & Harvey, 1988). An even closer reading of these stories can translate into a learning tool to help mathematics educators become more conscious of historical and current realities and challenge framings that prevent movement toward a more inclusive mathematics and engineering community.

I also explored the students' vulnerabilities, their resilience, and the presence of strong risk and protective factors in their social and academic lives. The literature often suggests several individual characteristics proposed to be protective (e.g., commitment to school, supportive family and school environments, resource rich neighborhoods), while other characteristics are proposed as risks (e.g., being Black, low maternal education, early child bearing, female-headed households, and perceived neighborhood "disorder") (Pezzella, 2006; Resnick et al., 1997). Researchers often theorize about resilience with predetermined characterizations of what they consider to be protective and what they consider to be risks based on White middle-class standards (Doll & Lyon, 1998; Ford, 1994; Gottlieb, 2001, 2004; Masten, 1994). Other models of resilience indicate the protective and risk factors should be determined by the study's participants, as they are the ones who utilize their perception in determining those factors (Miller & MacIntosh, 1999; Nettles & Pleck, 1993; Spencer, 2006). In conducting this study, I resisted generating generic labels of risk or protective factors as I perceived them. In other words, I did not generically associate being reared in a low-income neighborhood as a risk factor or being middle class SES as a protective factor, unless the students' presented it as such. Certain factors that students described as risks factors at certain points in their lives actually served as protective factors in other settings and vice versa (e.g., attending an "all" Black school, living in the "ghetto").

Additionally, I sought to deepen my understanding of how race—viewed as a social construct—and students' conceptions of and responses to race, affect their mathematics and engineering development. Lee (2008) explained in terms of identity classifications, why she focuses on race as opposed to other forms of discrimination:

> I focus on race because with ascribed racial classification comes exposure to institutional biases, prevalent cultural stereotypes, and outright persistent, intergenerational discrimination that crosses gender, nationality, and disability. Thus to ignore race is to take our vision away from ways in which our society institutionalizes challenges to particular groups of people. (p. 272)

Within mathematics and engineering education, researchers have only speculated about the role of race. My study confirms significant dynamics for high-achieving Black mathematics and engineering students: (1) the role and impact of racial and mathematics identity on mathematics and engineering achievement; (2) the racialized nature of mathematics and engineering learning and participation; and (3) achievement in mathematics and engineering in spite of daunting obstacles.

I bring into this study a critique of mathematics achievement outcomes that fails to consider Black students' experiences, not just their achievement (Martin, 2007). The primary methods that mathematics education researchers employ to examine the achievement outcomes of Black students are test scores and other traditional assessment measures. Looking at Black mathematics achievement by relying solely on test data overlooks or denies the experiences of these students and the ways in which they adapt to patterns of social inequity. These forms of biased intellectual interrogation ignores the significance and influence that race and color has on the American educational system (Graham, 1992; King, 1991; Ladson-Billings & Tate, 1995; Lynn, in progress; Martin, in press; Morgan, 1980; Noguera & Akom, 2000; O'Connor, Lewis, & Mueller, 2007; Omi & Winant, 1994; Sólorzano, Ceja & Yosso, 2000; Solórzano & Yosso, 2002a; Steele, 1992, 1997, 1999).

Although this work takes place in a college context, the results are relevant to the K-12 context as well, as students' reflective experiences aid researchers in identifying those key time periods in students' early school experiences where mathematics success and failure are negotiated (Martin, 2000).

Key Findings

Net Vulnerability: Risk and Protective Factors

This study exposed additional risk factors associated with being Black such as daily experiences of discriminatory behavior from teachers, peers, and educational institutions as a whole that are motivated by race. The research also shows that these risk factors specifically include experiences of racism in the mathematics and engineering classrooms that varied depending on how each student perceived the experience. The findings also show the presence of protective factors that help to offset these risk factors and impede other risk factors from developing. High academic achievement in mathematics and engineering acted as a protective factor that shielded the students in the study from some forms of adversity, but not all. Looking at the net vulnerability levels of the students' (i.e., the interplay of risk factors and protective factors), defined as risk and protective by the students themselves, demonstrates the agency and ability of the students to protect themselves. This finding counters statistics that assert, for example, that approximately 17 percent of White children are at risk compared to over 50 of Black children (Fitzpatrick, 1997). Research like this often compares Blacks, Latinos, and Whites with one another without considering that environmental factors, such as racism and classism, disproportionately place Blacks and Latinos or low SES individuals at risk. Additionally, the traditional literature all but dismisses the operation of protective factors that help in nurturing resilience, which develop over time and aid in mitigating negative stressful situations. The

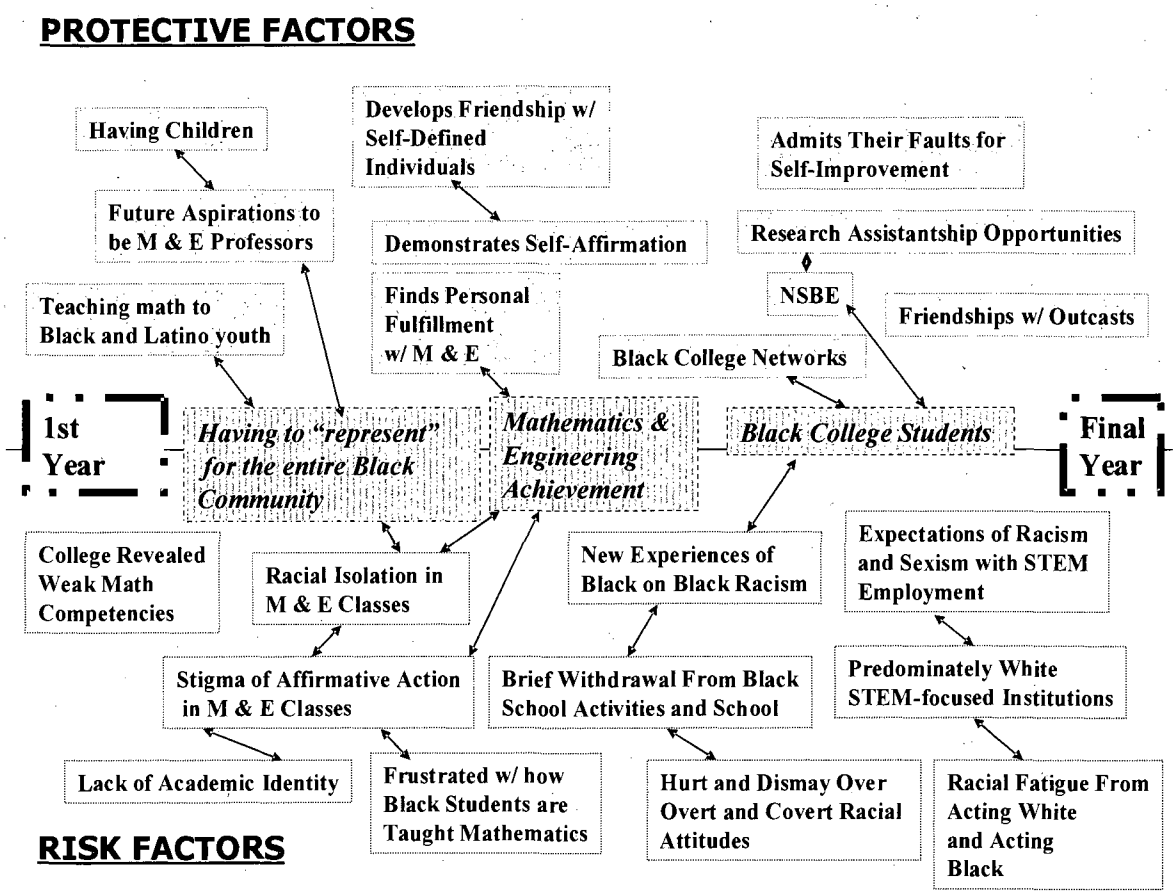
findings also reveal that resilience is not just a set of factors outside of the students' control (e.g., caring and supportive teachers, extracurricular activities, safe school environment, etc.), but are developed in concert with the students' identity (e.g., self-confidence, realistic self-assessment, awareness of racism, seeking out likeminded friendships, etc.).

In chapter 6, I provide an in-depth mapping of three students' risk and protective factors that developed over the course of their lives. Here I provide a snapshot of some of the more visible protective and risk factors that were prevalent for the 23 students in this study. This illustration is not exhaustive but provides a view of many of the shared protective and risk factors in operation during the students' college years (See Figure 1.1).

Unlike most of the existing research on mathematics and engineering achievement among Black students, my findings revealed important themes related specifically to success. The first significant finding relates to resilience and how resilience is developed, demonstrated, and framed by students. The results showed that the students moved between two trajectories of resilience: *fragile* and *robust*.

A fragile form of resilience is identified by strategies for high-achievement in mathematics and engineering that primarily focus on challenging the racial stereotypes about Blacks' abilities in general and mathematics in particular. Racial stereotypes are transmitted via social institutions with only generational modifications and are the result of historical racism (Steele, 1997, 1999). They are deeply imbedded in the psyche of all social institutions, including schools and the people inside them (Steele & Aronson, 1995).

The methods that were employed by the participants included a defiance of race-based expectations by way of strategies that I have defined as *racialized survival strategies*. The students also pursued academic and math success to their appease parents. These methods are



Solid Gray Boxes above Time Line: Protective Factors **White Boxes Below Time Line:** Risk Factors
Patterned Boxes Situated on Time Line: Serve as Both Risk and Protective Factors (Situationally Dependent)
Arrows: Participant Described Direct Correlation Between Factors/Processes
High Risk Factors + High Protective Factors = Net Vulnerability Level

College Years Protective Factors and Risk Factors: Net Vulnerability Map
Figure 1.1

considered fragile because the students were guided by other people's expectations of their mathematics and to a lesser extent engineering aptitudes. This form of resilience is most developed in the K-12 school years. The robust form of resilience incorporates more self-guided motivations to achieve in mathematics and engineering. The methods employed by the students to navigate mathematics and engineering achievements under the robust form of resilience include: testing and refining self-defined criteria; seeking out like-minded people, spaces, and

places; and learning to appreciate math and engineering for their own sakes. This way of achieving in mathematics and engineering is considered robust because it is self generated and defined involving the students' own identities and motivations for success. Additionally, success for these students was often tied to the socially conscious objective of becoming a role model for other Black learners.

My focus on resilience in my research question is uncommon in mathematics education, in that resilience in Black contexts is a grossly understudied phenomenon (Spencer, 2006). Some Black students do not succumb to the social conditions that create educational, cultural, and economic disparities, and they are able to effectively employ coping strategies to achieve. Although Black group membership and frequent marginalization carries an extra source of risk, the students in my study were able to transcend that risk in academically empowering ways (Spencer, 1999).

The second finding revealed the variability that exists between the participants' racial identities and the impact on their academic and personal lives. For a majority of the respondents, being Black was a central part of their identities and they strongly identified with others in their racial group. However, for a few students, being Black was not much of a consideration in their identities or lives. Another important consideration in the respondents' identities was the early development and maintenance of a strong mathematics identity (i. e., one's deeply held beliefs about being a "doer of mathematics"). A strong, yet uniquely self-tailored mathematics identity was an essential component of the students' mathematics and engineering longevity (Martin, 2000, 2006a, 2006b).

The third finding focuses on the use of adaptive strategies employed by the students as they encountered racial stereotypes and other forms of discrimination to negotiate successful participation in mathematics and engineering. Certain successful strategies surfaced in response

to racial discrimination and stereotyping. Some of these strategies include: adherence to racial stereotypes (acting stereotypically White or stereotypically Black), and using mathematics to be viewed as smart. Yet, the findings also show their academic success came with an emotional price. These results support the notion that emotion and cognition are complexly intertwined. When students were cognitively successful in mathematics and engineering they were not necessarily emotionally happy, particularly in the fragile form of resilience.

The fourth finding was the common articulation that their mathematics and engineering pursuits were situated within the larger contexts of Black political and educational struggle (Martin, 2006a). As a result of their experiences with race-based oppression and mathematics education, the concept of race played a major role in the lives of the participants.

These findings culminated in the development of a model of resilience. The results revealed two main motivations for and trajectories of resilience: (1) attempting to prove racial stereotypes wrong (Steele, 1997, 1999) and (2) the desire to serve as role models for Black learners. The model differentiates two forms of resilience and has implications for further study that will integrate considerations of identity formation processes and the racist nature of students' mathematical and life experiences. I expound on the definitions of the model in Chapter 4. In Chapter 5, I use *cross-case* analysis of twenty-three high achieving students. In this thesis, I will demonstrate the substance of my model of resilience and elaborate on the themes and strategies characterized by each form of resilience.

The Counter-narrative of the "Subjective" Researcher

This dissertation research also represents the convergence of three intersecting developmental aspects in my life (1) my experiences as a mathematically successful African American; (2) my mathematics research, teaching, and mentoring experiences with Black

students who exhibited academic and personal resilience; and (3) my critical analysis of research on mathematics learning and participation among Blacks. These experiences demonstrated the need for rigorous research to extend the knowledge base and that contributes to a fuller understanding of Black students in mathematics and engineering, and to highlight the factors that foster success rather than failure.

A primary purpose of this study is to deepen the understanding of these students' experiences and to develop new understanding of their experiences. My research included an iterative process between the participants and I based on participants' responses and reflections to the interview questions (Strauss & Corbin, 1997). Including the voices and experiences of these marginalized students required me to be self-reflexive throughout the research, analysis, and writing processes (Denzin, 1994). The participants' stories also included parts of myself that are shared, mutually known and commonly experienced (inter-subjectivity). I learned how to become an authentic listener and held sacred the dialectic relationship between myself and the storytellers. My methodology draws on phenomenology; deepening my level of consciousness through seeing, intuiting and reflecting upon my everyday lived experiences. This heuristic research approach "encourages an individual to discover, and methods which enable him [her] to investigate further by himself [herself]," (Moustakas, 1981, p.207). The participants and I engaged to explore some significant aspect of their lives, to understand it better and hopefully to transform our actions so as to collectively meet our purposes more fully (Reason & & Bradbury, 2001). The result of this collaboration was greater than the sum of our individual selves and thus created a stronger voice.

Counter-stories, like stories, are also told from the perspective of the storyteller. However interpretation of the students' experiences is a function of my historical experience, fundamental values about the world, and the belief systems upon which my values are based.

Counter-stories can serve as "a bridge between individual experience and systemic social patterns...their analysis can be a potential tool for developing a more critical consciousness about social relations in our society" (Bell, 2003, p. 4). The use of counter-stories allowed me to revisit racial themes, some of which have explored before and some that have not been exposed in mathematics and engineering. The use of counter-stories resulted in narratives constructed out of historical, socio-cultural, and educational realities of these Black mathematics and engineering college students (Ladson-Billings, 2006).

Having successfully negotiated the mathematics pipeline, majored in Electrical Engineering, graduated from an historically Black university, and earned a Master of Science degree in Industrial Engineering, I quickly realized that the current research on Black students and mathematics and engineering education has not reflected the experiences of my peers who have excelled in math and engineering. For example, Martin (2000) argued that many of the studies investigating the mathematics achievement of African American students focus exclusively on student failure. The focus on failure does not allow researchers to account for intragroup achievement differences; or student success, resiliency, agency, and motivation among Black students. Additionally, many studies lack historical context, often failing to conceptualize achievement and persistence beyond the effects of personal background or in-school factors, and often ignoring the role of larger socio-historical and structural forces (Martin, 2000, 2006a, 2006b). Insightful research of this nature is needed. A review of the literature within mathematics education shows that there exists a small number of studies addressing these outcomes (Ladson-Billings, 1997; Martin, 2000, 2007; Moody, 2001; Powell, 2004; Sheppard, 2006; Stinson, 2004, 2006; Thompson & Lewis, 2005; Walker, 2006). My research serves to fill this void.

I approached this research with a personal commitment to comprehend issues affecting the experiences of high achieving Black college students. As a Black female mathematics student and teacher, I brought to bear my racialized and gendered experience, along with a perspective of being historically silenced and constantly challenged while developing her own mathematics literacy and identity. My own personal triumphs in mathematics and engineering success fueled my commitment to this work and to honestly and accurately represent the participants' stories.

It is important to be a culturally sensitive stakeholder (hooks, 1992; Twine, 2000). Commitment to the cause of educational change in mathematics and engineering education for Black students is not conducive to "hit and run" research with no stake for the researcher in the process (Jones, 2002; McMillan & Schumacher, 1997). My insider status (as a Black engineering degreed individual) brought risk to the study by my subjectivity; this had to be managed so that it did not compromise my interpretations. My subjectivity required reflection and monitoring as it had influenced my initial desire to embark on the study. According to Tillman (2002), subjectivity can, and as did in this study, shaped my sampling, the questions posed, and the conclusions arrived at. Also, subjectivity manifested itself as a desire to offer a holistic explanation of these students' mathematics and engineering achievements.

It is appropriate for a researcher to acknowledge biases as these can predispose one to interpreting behaviors in certain ways (Graham, 1992). I acknowledge at the outset of this study my predispositions, making every attempt to resist the tendency to over-identify myself with the student participants and to balance my reactions to events and interactions with the emic perspectives of the study's participants (Ford, 1994; Milner, 2007). In particular, I addressed my biases or assumptions during data collection and analysis via discussions of the data and preliminary analyses with my dissertation advisor and committee members in order to curtail

any biases or assumptions. To gain critical feedback and reflection, data was presented to other researchers at colloquia and conferences.

These stories showcase the patterns of Black high-achievers within socially-valued academic arenas. This was not merely as an intellectual exercise, but a very personal and emotional experience for me. Writing their stories gave me an opportunity to create the type of counter-narrative that offsets the traditional gap-gazing literature that over-populates the current knowledge on Black mathematics and engineering achievement (Lawler, 2005).

Limitations of the Study

No research is without limitations. One limitation of this study is the use of only four urban universities. The four chosen universities provided a limited representation of the kinds of institutions attended by Black mathematics and engineering students. I would need to recruit students from many more universities to capture a broader range of Black experience in mathematics and engineering to offset this limitation.

A second limitation is the number of students interviewed for this study. I included 23 adult-age college students. However, the goal of the study is not to necessarily produce generalizations. However, mathematics educators are providing examples of qualitative studies that produced highly generalizable findings through providing a depth analysis that enabled other researchers to understand a phenomenon more clearly and judge its applicability to like cases (Boaler, 2008; Erlwanger, 1975). Furthermore, Erlwanger's (1975) case study of a single child is considered as one of the most influential studies in the field of mathematics education. Boaler (2008) states:

> The degree of generalizability rests not only with the number of cases consulted or randomization of subjects, but with the power of observation and analysis produced within a study. (p. 592)

I believe my analysis can play a significant role in understanding the links between Black students and mathematics achievement and patterns of participation and will become part of a knowledge base that can be understood by mathematics educators, parents, students, and the mathematics community.

The data gathered from these participants cannot represent the responses of all Black mathematics and engineering learners from these schools or the larger environments. Rather, I am providing a qualitatively rich, principled investigation of the experiences of my participants. Moreover, data collected from these 23 students will add to knowledge gained from similar studies conducted by other researchers.

Third, the study is limited by the self-selection of the participants. Helms (1990) stated the self-selection in racial identity studies may result in research participants with more pronounced racial attitudes. Those who inquired about this investigation were not initially aware that the study was investigating racial identity; this may have eliminated some bias. Yet additional bias may have arisen from respondents who were interested in the study's topic.

A fourth limitation of this study is the researcher's reliance on self-reported data and interviews rather than monitoring actual decisions or behaviors of the participants. This reliance only on verbal interviews might limit their research value.

Despite these limitations, this study provides a "voice" for *successful* Black mathematics and engineering college students. This analysis will add important data to the literature on African American mathematics and engineering achievement.

Organization of the Dissertation

This dissertation is organized as follows:

Chapter 2 provides a comprehensive, yet succinct, literature review that clarifies mathematics education from its conventional conclusions regarding mathematics achievement for Black students, to its recent movement to progress beyond failure as normative, as emergent researchers problematize socially constructed paradigms that impede their mathematical achievements. This review establishes the relevance of identity construction in mathematics learning and participation. Since Blacks in America have a history of oppression and discrimination, this literature review also incorporates research highlighting race and racism as important considerations for Blacks and extends its discussion to researching race in mathematics education. The literature review concludes by highlighting resiliency in ways that help explain and contribute to the diverse ways that Black students successfully cope with challenges.

Chapter 3 describes the methods, sources of data, and instrument used in this study.

Chapter 4 explains a developing model entitled *Trajectories of Resilience Among Successful Black Mathematics and Engineering Students,* which is an extension of the *Phenomenological Variant of Ecological Systems Theory* model (Spencer, 2006). The results of the analysis maps two trajectories of resilience (fragile and robust) for successful Black mathematics and engineering college students. The development of this model contributes to an understanding of the co-construction of identity (mathematical, racial, and other social identities) to better comprehend the participants' intentions within their learning spaces and environments. The results showed that the students' co-constructed identities overlapped and intersected in academically

nurturing ways. Equally important is the recognition of protective factors that can help offset the disproportionately high number of risk factors for these students.

The model has three levels: (1) the motivation involved for pursuing success, (2) the strategies employed to ensure success, and (3) the outcomes each of these forms of resilience has on the students' mathematical and racial identity. The students employ strategies to succeed in mathematics and engineering that also develop from the fragile into the robust. The first two levels are bi-directional, meaning that students began their mathematics careers with a fragile form of resilience and then developed, usually in their high school years, a more robust form of resilience. Within the robust form of resilience the fragile form is still present, but minimally so. While striving in the robust form of resilience, some situations still require students to utilize strategies within the fragile form of resilience. The last level of the model, the outcomes, is not bi-directional. Once students transition from the fragile to the robust form of resilience, the outcome for mathematical and racial identity remain in the robust form, regardless of the situation or use of the fragile motivation and strategies.

Chapter 5 elaborates on the model via cross-case analyses. This allows for comparison of the data from the 23 cases and to discern patterns or themes. The intent of the study was not evaluative, but rather to describe the reality of the Black students' lives in their pursuit of mathematics and engineering success. *Counter-narrative* and case-study methods were used to explore and analyze the students' racial and mathematical identities to locate factors that accounted for their resilience. More specifically, cross-case analysis confirmed that the participants underwent a developmental shift from fragile to more robust forms of resilience. The Multidimensional Inventory of Black Identity (MIBI) was also administered to complement the exploration of the respondents' emerging identities of being Black, particularly in academic arenas where Black presence is scarce.

Chapter 6 examines, through case-study analysis, 3 of the 23 students' personal life histories. Their histories detailed their experiences in the home, schools, neighborhoods, and workforce, with a particular focus on the role of race while negotiating their mathematics and engineering achievements. This study further dissects the experiences of these three students using the life-story interview approach. The results of this phase of the research are indispensable for understanding the diverse strategies by which academically successful Black college students interpret and respond resiliently to their subjugation, in ways that promote academic and personal success. These three case study analyses are representative of the larger participant group.

Chapter 7 summarizes the study and offers implications of this research for students, teachers, and the mathematics education community.

CHAPTER 2

LITERATURE REVIEW

> Throughout two centuries of slavery, a century of court sanctioned discrimination based on race, and a half of century of differential access to education by race, class, language background, and geographical location, we have become accustomed in the United States to educational inequality.
>
> *- Darling-Hammond, 2007, p. 318*

This literature review begins with an overview of research on Black students in the United States and their particular challenges as mathematics and engineering learners. I briefly outline conventional perspectives on their challenges and then question traditional explanations for Black mathematics underachievement. Next, I discuss an emerging mathematics literature that offers a more holistic perspective of Black mathematics education that provides space for investigating mathematics success for this population. Although I draw most of this literature review from mathematics education (due to vastly larger research base), I acknowledge the emergence of critical engineering education research and statistics.

Mathematics Achievement Among Black Students: Conventional Perspectives

As a result of educational inequities and court-sanctioned discrimination that institutionalized differential access to education by race, Black students in America have endured myriad hardships that often challenged and impeded their academic achievements. A number of researchers have documented the inferior education, lack of resources, obsolete textbooks, dilapidated facilities, and inexperienced teachers that are commonplace in predominantly low-income Black communities (Anderson, 1988; 2004; Darling-Hammond, 2007; Hale, 2001; King, 1991; Kozol, 1991; Lewis, 2003; Noguera, 2003; Oakes, 1990; Perry, 2003).

Nowhere has this compounded discrimination and differential access been more evident than inside mathematics classrooms, which are rife with gross inequities (Stiff & Harvey, 1988, Martin, in press).

Over the past 28 years, many reports have explored the underachievement and limited persistence of Blacks in mathematics (Anick, Carpenter, & Smith, 1981; Entwistle & Alexander, 1992; Fullilove & Treisman, 1990; Oakes, 1990; Oakes, Joseph, & Muir, 2001; Secada, 1992; Stiff & Harvey, 1988; Tate, 1997). One of the most disturbing facts about U.S. education is that fewer than 10 percent of American children complete the sequence of high school mathematics courses - algebra, geometry, trigonometry, and pre-calculus - that are required in many other countries (Campbell & Evans, 1997; Schmidt, 2003). Learning and participation in mathematics for Blacks have been consistently hampered by persistent tracking and differential access to higher-level mathematics curricula; poor access to the best-qualified teachers and inadequate resources for learning mathematics (Oakes, 1990); and limited opportunities to connect school mathematics to their lived realities (Martin, 2000; Martin & McGee, in press; Moses & Cobb, 2001; Nasir & Hand, 2008; Powell, 2004; Spencer, 2008a, 2008b; Tate, 1994, 1995a). Most Black students are turned away from mathematics and science very early in their educational experience (Moses & Cobb, 2001; Pennington, 2000; Stiff, 2005; Tate, 1995a, 1995b).

Achievement disparities between Black and White students persist from about fourth grade into collegiate settings (Lubienski, 2002a, 2002b; National Center for Education Statistics, 2003; Oakes, Joseph, & Muir, 2001; Tate, 1997; Tate & Rousseau, 2003). In the 2000 U.S. Census, African Americans represented 12.0 percent of the population, but only 3.9 percent of engineers and less than 3.0 percent of mathematicians in the United States (National Science Board, 2006).

In the United States they are over 2 million people employed in the engineering profession (U. S. Department of Labor, 2004). In engineering, during the period between 1994 and 1998,

engineering employment increased over 20%. During this same period, Black enrollment in engineering programs was down 17%. In 1997, only 5% of Bachelor's of Science degrees, 2.1% of Master's degree, and 1.2% of PhD's in engineering were awarded to Black students (National Science Foundation, 2002). The number of underrepresented minorities enrolled as full-time, first-year students in engineering declined by 5% overall from 1992 to 1996. The loss among African American engineering enrollment during this same period fell by 16%; loss among Hispanics was less at 3% (Engineering Trends, 2004).

Explanations for these achievement and persistence disparities have tended to fall within four categories (Martin, 2000):

- Blacks lack problem-solving and higher-order thinking skills as evidenced by performance on tests and the resulting "achievement gap" (Madaus & Clarke, 2001; Thernstrom & Thernstrom, 1997);
- Students' home lives are such that they receive little preparation for formal schooling and little support for their education once they enter school (Thernstrom & Thernstrom, 1997; Obgu, 1991, 1992, 1994);
- Blacks are often tracked into low-level classes and are not given access to high-quality teaching, curriculum, and other school resources (Lubienski, 2001a, 2001b, 2002; Oakes, 1985; Oakes, et al., 2001);
- Curriculum materials and teaching styles are not culturally relevant and conflict with the learning and language styles and cultural knowledge of Black learners (Boykin & Allen, 2000; Gay, 2000; Hale, 2001; Ladson-Billings, 1998; Malloy & Malloy, 1998).

While some of these perspectives lend support to those who argue for "achievement gaps" and "race gaps" in mathematics, my dissertation did not follow these lines of inquiry. Like

Martin (2009), I do not take achievement differences as reflecting faults or deficiencies in Black students. Rather, these differences merely reflect the conditions in which students are expected to learn and the low expectations for their achievement.

The absence of a concentrated effort by the mathematics and engineering education community at large to improve the recruitment and retention rates of Black students on all academic levels poses a monumental problem for the mathematics and engineering communities as it continues to strive for social and economic justice and increased opportunities to create lasting change (Asagba & Antwi-Boasiako, 2004). Because most Blacks students have less favorable opportunity to acquire a sufficient mathematics background prior to college entry, they are essentially eliminated from a countless number of careers, ranging from the physical sciences and engineering to those in the social sciences and psychology (Anderson, 2002). Thus, the underrepresentation of Blacks in college mathematics and engineering-based programs and in the professoriate has resulted in a loss of talent to society and the loss of important role models for the next generation of Black students who aspire to educational and professional careers (Moses & Cobb, 2001).

Conceptualizing Race (in the Lives of Black Students)

Since race is deeply and systemically linked to the dynamics of education and to school inequality and discrimination (i.e., opportunity to learn and teacher expectations) investigation of race is necessary when looking at Blacks and education. Academic achievement research for Blacks resulted in "under-theorized, oversimplified, or inaccurate conceptualizations of race" (O'Connor, Lewis & Mueller, 2007). Researchers use several approaches to better understand the roles that racism plays in the education of Black students, including understanding the interplay between everyday racism (e.g., Essed, 1991, 2002), institutional racism (e.g., Lewis,

2003), structural racism (e.g., Bonilla-Silva, 1997, 2001, 2003), and focusing on colorblind racism (e.g., Bonilla-Silva, 2003). Emergent research that problematizes this society and the schooling system suggests that Blacks live and learn in cultural and social space that is racialized (Anderson, 1988, 1995, 2001, 2002; Bell, 1995; Hale, 2001; Mickelson, 2003; Mills, 1997; Noguera & Akom, 2000; Walker, 1996 Woodson, 1990). In other words, in the context of learning and participation in this society, racism continues to play an integral role in academic achievement.

Because of the social status and subsequent treatment that comes with being Black, identity becomes a salient marker for comprehending school learning and participation of Black students. Furthermore, understanding factors that promote or hinder meaningful participation in mathematics for Black students requires a more in-depth appreciation of their identities (Berry, 2003, 2005; Martin 2000, 2006a, 2006b, Martin & McGee, in press, Moody, 2003; Sheppard, 2006).

Prior theories investigating race discourse acknowledge simplistic forms of racial and ethnic differences (e.g., holidays and food), while suppressing more critical tensions (e.g., the role of everyday racism in schools). In the face of a new, more "quiet" form of racism, the myth of a colorblind democracy is widely promoted, which weakens the pressure for actual equity in education (Bonilla-Silva, 2001, 2003; Books, 2004; Lee, 2002; Shapiro, 2004). Deeply embedded norms of White supremacy help to maintain persistent racial segregation in residential, educational, social, and career opportunities (Brown & Wellman, 2005), as a host of advantages that are bestowed on Whites accumulate to compound generational White privilege and Black disadvantage (Lani & Gerald, 2003).

Traditionally, our society defines race by the similarities and differences in physical characteristics, such as skin color, hair texture, and bone structure (Bonilla-Silva, 2003). However, the definition of race is far more complex than distinguishing phenotypes. In this

study, I utilized the definitions of race and racism provided by Essed (2001) as noted in Martin (2009):

> [Because] "race" is an ideological construction with social expressions (racialized or "ethnicized" structures of power), racism must be understood as ideology, structure, and process in which inequalities inherent in the wider social structure are related, in a deterministic way, to biological and cultural factors attributed to those who are seen as a different "race" or "ethnic" group. Furthermore, racism is a structure because racial and ethnic dominance exists in and is reproduced by the system through the formulation and application of rules, laws, and regulations through access to and the allocation of resources. Finally, racism is a process because structures and ideologies do not exist outside the everyday practices through which they are created and confirmed. These practices both adapted to and themselves contribute to changing social, economic, and political conditions in this society (p. 185).

Scholars, who study hegemony (i.e., the act of political and social domination of the ruling class in capitalist society, which is pervasively expressed not only in ideologies but in all realms of culture and social organization) argue that race serves the purpose of combining a group of people into the same social group regardless of socioeconomic status to allow for its political, social, and educational oppression (Morgan, 1980; Omi & Winant, 1994). Gunaratnam (2003) acknowledged that conceptualizations of race "are not *objective* stable, homogenous categories but are produced and animated by changing, complicated and uneven interactions between social processes and individual experience" (p. 8).

Ladson-Billings & Tate (1995) and others (Bell, 1995; Delgado & Stefancic, 2001; Dixson & DeCuir, 2004; Ladson-Billings, 1999; Lynn, 2004, in-progress; Parker & Stovall, 2004; Solórzano, 1997; Solorzano, Ceja, & Yosso, 2000) used Critical Race Theory () to analyze educational inequities. In theorizing race, they drew upon Omi & Winant's (1994) racial formation theory to unpack the structural and cultural significance of race in education. Scholars committed to issues of race in education have used CRT in order to address and analyze myriad school inequities that Black students endure. CRT has been used as a framework for examining "persistent racial inequities in education, qualitative research methods, pedagogy and practice,

the schooling experiences of marginalized students of color, and the efficacy of race-conscious education policy" (Lynn &Parker, 2006, p. 257). Critical Race Theory aids in solving the educational problems of Black students and other marginalized students of color by:

(1) Drawing from an historical perspective that incorporates the work of critical legal scholars and education scholars concerned about racism in education;

(2) Extending and expanding the "scholarship of the people," which is overwhelmingly by scholars of color, for people of color, affected by or concerned about education;

(3) Allowing for linkages between itself and other "race-based epistemologies" (e.g., Black racial identity), to provide a more holistic approach for illuminating and solving problems in education; and

(4) Giving credence for critical race scholars in education to view CRT as both a form of academic scholarship and a form of activism.

In total, these frameworks to investigate the socially constructed nature of race have allowed for a more productive consideration of the role of race, racism, and other constructions that create educational apartheid in the lives of Black students in this study.

Researching Race in Mathematics Education

There is a lack of research within mathematics education to deal with the complexities of race and racism that produce the unequal outcomes in mathematics learning and participation (Martin, 2006a, 2006b, 2007, 2008, 2009). A careful reading of the existing literature in mainstream mathematics education reveals a distortion of the concept of *race* and an inadequate theorizing of *racism* in the lives of African Americans (Martin, 2007, 2009). Martin (2009) has noted:

> Within mathematics education research and policy, both race and racism remain undertheorized in relation to mathematics learning, participation, and differential outcomes in achievement and persistence. While race is characterized in the sociological and critical theory literatures as an ideological construction with structural expressions, most studies of differential outcomes in mathematics education begin and end their analyses of race with static racial categories and group labels used for the sole purpose of disaggregating data. One consequence is a widely accepted, and largely uncontested, racial hierarchy of mathematical ability. Disparities in achievement and persistence are inadequately framed as reflecting race effects rather than as consequences of the racialized nature of students' mathematical experiences. (p. 315)

Martin further argues that this society has developed a *racial hierarchy of mathematics ability* that places White and Asians on top and Blacks, Latinos, and Native Americans squarely on the bottom (Martin, 2007, 2009).

Martin's studies (2000, 2003, 2006a, 2006b, 2007, 2008, 2009) have sought to directly examine the beliefs of African American mathematics learners about constraints and opportunities associated with mathematics learning and participation. Martin sums up the struggle of African Americans for education as two-fold: (1) for meaningful participation in schooling and the larger opportunity structure mathematics, and (2) emblematic of a culturally based philosophy of education: *freedom for literacy and literacy for freedom* (Perry, 2003). Moreover, Martin (2006a) presents the oppositional voices of African American students who have actively "resisted their continued subjugation based on a belief that mathematics knowledge, beyond its role in schools, can be used to change the conditions of their lives" (p. 7). For many, *being Black* and being a doer of mathematics are often framed in terms of differential treatment, struggle, and resistance. I have embraced Martin's work because it sheds light on discriminatory experiences inside and outside mathematics that continue to subjugate the Black community.

Martin has also asserted that mathematics learning and participation can be conceptualized as racialized forms of experience (2006a, 2006b, 2007, 2009). Mathematics learning and participation as racialized forms of experiences suggests that students' experiences, identities,

and outcomes in mathematics are structured by the meanings and relations of race that exist in the larger society. These meanings and relations shape how learners are framed and constructed, how mathematics competence and ability are conceptualized, and how the aims and goals of mathematics education are decided. Outcomes in mathematics education that are analyzed through, and attributed to, race are then used to reinforce meanings and relations in the larger society. This conceptualization contrasts with culture-free and situated perspectives of mathematics learning often found in the literature.

Identity and Black Students

Identity is a term used throughout the social sciences to describe an individual's comprehension of him or herself as a discrete, separate entity (Cote & Levine, 2002). In sociology the notion of social identity is defined as the way that individuals label themselves as members of particular groups (e.g., nation, social class, subculture, ethnicity, gender, etc.) (Bourdieu, 1986, 1991). Wenger (1998) proposed that there is a dynamic and complex relationship between identity and learning in academic contexts. He argues that learning is not simply a process of one-way appropriation, but a process of multidirectional change in identity over time (Lave & Wenger, 1991).

At the structural level, many Black identities reflect divisions in U.S. society that are marked by systematic material and power inequities (Apple, 1992, 1995; O'Connor, 2001). Those who study Black students and their identities suggest that racial identity has a significant influence on academic achievement (Cross, Parham, & Helms, 1998; Phinney & Alipuria, 1990; Sellers, Rowley, Chavous, Shelton, & Smith, 1997; Sellers, Smith, Shelton, Rowley, & Chavous, 1998; Tatum, 2004). Due to the potential consequences of a racial identity that strongly identifies with Black race, I became interested in understanding how racial identity impacts high-achieving

Black college students. More specifically, did a sense of racial identity that strongly identifies with being Black play a role in the high academic mathematics and engineering achievement for the respondents?

Racial Identity

Identity was an important concept to consider in this research as the focus was on understanding the ways in which Blacks learn mathematics and engineering and experience their world (Gainor & Lent, 1998). Examining, from the students' perspective, the interplay between racial and mathematical identity and the effect such a nexus might have on mathematics learning and participation is fundamental to this study's results.

Blacks in America have a history characterized by oppression and discrimination, which has contributed to a unique "raced" identity. The role of racial identity—that is, the extent to which societal and personal meanings of race influence a person's self-concept and consequent behavior (Cross, 1991; Helms, 1990; Sellers, Smith et al., 1998)—in the lives of Black students is a complex phenomenon. Extant theoretical and empirical work in psychology, sociology, and social psychology has demonstrated links between racial identity and positive psychosocial adaptation (Banks & Banks, 1993; Cross, 1991; DuBois, 1973; Sellers, Chavous, & Cook, 1998; Sellers, Smith, et al., 1998; Steele, 1997, 1999). Although research in this area is still emerging, it is generally accepted that a less salient Black racial identity is associated with poorer outcomes, whereas a strong and positive group affiliation is related to more positive outcomes (Chavous, et al., 2003; Harper, 2007; Oyserman, 2008; Sellers, 1993).

Racial identity is also based on one's *perception* that an individual shares a common racial heritage with a particular racial group (Cross, 1991; Helms, 1990; Sellers et al., 1997). The literature on racial identity development among Black students also suggests that realistic

beliefs about race play a protective role in their lives. Students who identify strongly with their racial group are better able to negotiate potentially negative environments, deal with discrimination and prejudice, and have high self-esteem (Bowman & Howard, 1985; Harpalani, 2002; Rowley & Moore, 2002; Sanders, 1997).

The Cross (1991) model of *Nigrescence* is frequently used to conceptualize Black racial identity. It describes five stages of racial identity development: (1) preencounter (i.e., race is not important), (2) encounter (i.e., racial experiences prompt a reexamination of racial issues), (3) immersion/emersion (i.e., being pro-Black and anti-White), (4) internalization (i.e., inner security and satisfaction about being Black), and (5) internalization-commitment (i.e., a translation of internalized racial identities into action). *The Racial Identity Attitudes Scale (RIAS)* (Parham & Helms, 1981) is the instrument most often used to operationalize Cross's Nigrescence model. A direct link between racial identity and a number of outcomes for Blacks is typically measured.

Drawing on Nigrescence theory (Cross, 1971, 1991), Helms's (1990) model measures an individual's attitudes, thoughts, feelings, and behaviors toward oneself and others with respect to racial group membership. Helms's (1990) model of Black racial identity proposes that Black people can move from having self-degrading racial identity attitudes to self-enhancing racial identity attitudes in which they are secure about their own racial group and appreciate people from other racial and cultural backgrounds. The model consists of the following ego identity statuses: pre-encounter, encounter, immersion-emersion, and internalization (Helms, 1995, 1996). According to Helms (1995), each status represents a "world view" through which people organize racial information about themselves, other people, and institutions. At any one point, an individual may endorse attitudes from each of the four ego statuses, with one predominant status that has the largest influence on the individual's worldview (Helms, 1996). An

individual's level of racial identity, therefore, is not static and linear but can recycle through different statuses over time.

A methodological limitation of most racial identity models (Marcia, 1966; Phinney, 1989; Phinney & Alipuria, 1990; Phinney, Cantu, & Kurtz, 1997) including the Nigrescence model, is that these tools vary and often do not consider the content of the individual's racial identity. In other words, most instruments do not assess the significance or meaning that individuals ascribe to being a member of their racial group. Most models simply imply that there is some consensus around both the significance and meaning of *being Black* among African Americans. Others have suggested that using a multidimensional approach to measuring racial identity is important for better specifying how different dimensions of racial identity may influence academic achievement (Clark & Clark, 1939; Perry, Steele, & Hilliard, 2003; Phinney & Alipuria, 1990; Shelton & Sellers, 2000).

In an effort to provide an integrated view of Black racial identity that reflects consideration of a number of cognitive and situational components, Sellers and his colleagues (Sellers et al., 1997; Sellers, Shelton, et al, 1998) introduced the *Multidimensional Model of Racial Identity (some)*. The MMRI acknowledges that some Blacks can think differently, have different cultural styles, communicate differently, etc., and that analyzing and understanding these differences is key. The MMRI represents a synthesis of ideas from many existing models of Black racial identity (Sellers, Shelton et al, 1998) defines racial identity as that part of the person's self-concept that is related to her/his membership within a race. This model is concerned with both the significance the individual places on race in defining him/herself and their interpretations of what it means to be Black.

The MMRI proposes four dimensions of racial identity: the *salience* of identity; the *centrality* of the identity; the *ideology* associated with the identity; and the *regard* in which the person holds

African Americans. The first two dimensions address the significance of race in the individual's self-definition (Salience and Centrality); the second two dimensions address the qualitative meaning that the individual ascribes to being Black (Racial Ideology and Regard). The *Multidimensional Inventory of Black Identity (MIBI)* is the instrument used to measure three of the four dimensions of the MMRI.

Although some researchers prefer the term ethnic identity because it describes a group's social group and heritage, the MIBI incorporates the significance of both ethnic and racial identities into its analysis. The model is unique in that it explicitly states the importance of ethnicity to an individual's self-concept that varies from person to person.

The discourse in the literature regarding the MMRI supports the importance of the theory's conceptual issues, such as the fact that racial identity is dynamic across situations (Cross, 1991; Erikson, 1963; Phinney, 1989); that the salience of race is conceptualized differently for African Americans according to their individual beliefs (Asante, 1991; Boykin, 1986; Fordham, 1988; Obgu, 1991; Steele, 1997); and that racial identity cannot be understood without examining the larger social context (Lewis, 2003; O'Connor et al., 2007; Tatum, 1997).

Recent racial identity research has found that Black students with pro-Black, yet realistic, perceptions of racism are better adjusted in terms of overall self concept and ability to cope with race-based barriers in their lives (O'Connor, 1997; Sellers, Chavous, & Cooke, 1998). For example, O'Connor (1997) found that the low income, high-achieving African American high school students articulated with acute recognition the relationship between oppressive social and educational structures and their agency. Similarly, Altschul, Oyserman, and Bybee (2006) showed that Black students get better grades in school if they connect their racial identity with academics. Rowley, Sellers, Chavous, and Smith (1998) reported that private regard is positively associated with self-esteem among Black adolescents.

Mathematics Identity

Mathematics educators are beginning to closely examine issues of identity. An emerging literature of research has established the relevance of identity construction in mathematics learning and participation (Boaler & Greeno, 2000; Cobb & Hodge, 2002; Cobb & Nasir, 2002; Gutierrez & Rogoff, 2003). However, only a small number of researchers have conducted research on mathematics identity in African American contexts (Berry, 2003,2005; Jackson, 2006; Martin, 2000, 2006a, 2006b, 2007; Nasir, 2000, 2002; Spencer, 2008a, 2008b; Stinson, 2004, 2006).

Martin's (2000, 2006a, 2006b) research with African American learners took into account the historical legacy of slavery and recognition of the continuation of segregation and discrimination, and how these shared experiences contribute to a collective identity of what it means to be Black. Martin (2006a) considers the co-construction of African American identities and what he calls a *mathematics identity*:

> Mathematics identity encompasses the dispositions and deeply held beliefs that individuals develop about their ability to participate and perform effectively in mathematical contexts and to use mathematics to change the conditions of their lives. A mathematics identity encompasses a person's self understandings as well as how they constructed by others in the context of doing mathematics. Therefore, a mathematics identity is expressed in narrative form as a negotiated self, a negotiation between our own assertions and the external ascriptions of others. Math identities are always under construction. (p. 206)

Nasir (2002) contended that identity is related to a person's participation in particular communities and that the relationship between learning and identity can serve as a fruitful framework for understanding culture, diversity, and mathematics learning.

Berry's (2005) analysis of two mathematically successful African American male middle-school students extended beyond considerations of traditional support systems to include: proactive racial socialization and positive self-definition and motivation to succeed in mathematics and school. Thompson and Lewis (2005) profiled a young African American male,

who, from an early age, realized the importance of advanced mathematics to his college and career goals and fought his school for the right to take higher-level mathematics courses. Walker (2006) analyzed the role of peer influences on 21 mathematically successful African American and Latino high school students with an historical tradition of intellectual community networks. Walker's results revealed the presence of strong peer relationships with friends who shared their interests in mathematics or served as resources to assist in their study and understanding of mathematics.

Stinson (2004, 2006) conducted interviews with four mathematically successful African American males, using *Critical Race Theory* and key postmodern frameworks. Stinson's findings revealed that the participants had acquired strong mathematics identities that positively impacted their sense of agency. Stinson's (2006) participants "actively accommodated, resisted, or reconfigured the specific discourses that surround African American males" (p. 480).

Moody (1998, 2001) examined linkages between African American students' sociocultural orientations, personal and cultural identifications with mathematics, and their successful developmental process in mathematics.

This research challenges the perspectives that failure and limited persistence in Black students learning and participating in mathematics is normative. These educators boldly speak against the comparative statistics between Black and White students that do not capture the full range of problems confronting Black mathematics learning and participation. As a critical defense, emergent mathematics education scholars offer research that problematizes the complexities of test score data, race and racism, opportunities to learn mathematics, identity issues, and a host of additional constructs that produce unequal affects in mathematics learning.

Resilience

In framing this study, I was particularly interested in how Black students achieve and sustain success in the racially stereotyped and competitive fields of mathematics and engineering. Most of the students in this study not only dealt with racialized experiences inside and outside of the classroom but socio-economic hardships as well. Yet these hardships fueled their drive for academic success.

For more than two decades, public and educational discourse has focused on "children and families at risk," which have been overwhelmingly African Americans (Spencer, 2006). Researchers are now studying the resilience and talents of Black individuals, families, and communities (Arroyo & Zigler, 1995; Barbarin, 1993; Freiberg, 1993; Garmezy, 1991; McAdoo, 1997; Rutter, 1987; Spencer, Cole, Dupree, Glymph, & Pierre, 1993; Werner, 1989). Within the existing literature, *resilience* is defined as the ability to "bounce back, recover, or successfully adapt in the face of obstacles and adversity" (Miller & MacIntosh, 1999, p. 159). A more comprehensive definition was provided by Gordon (1995):

> Resilience is the ability to thrive, mature, and increase competence in the face of adverse circumstances. These circumstances may include biological abnormalities or environmental obstacles. Further, the adverse circumstances may be chronic and consistent or severe and infrequent. To thrive, mature, and increase competence, a person must draw upon all of his or her resources: biological, psychological, and environmental.

Resilience entails the ability to cultivate strengths (Silliman, 1994) and repair of one's self after hardship (Wolin & Wolin, 1993). In their review, Hawley and DeHaan (1996) found three common attributes in the resiliency literature: hardship, buoyancy, and wellness.

Yet, researchers investigating the academic achievement of Black students have located "at-riskness," in the lives of Black youth, their families, and their cultures (Herrnstein & Murray, 1994; Jacob & Jordan, 1993). For example, social science research has generally identified

poverty, a socially constructed crisis, as the factor most likely to put students "at risk" for drug abuse, teen pregnancy, violence, and school failure (Werner & Smith, 1992). This approach has led to stereotyping, tracking, prejudice, discrimination, and lowering expectations for many low-income Black students. Looking at Black students and their families through a deficit lens obscures recognition for their perseverance, strengths, individuality, and uniqueness.

Recent studies have demonstrated both the ways that Black students develop successfully despite risk and adversity, and the lack of the predictive power of risk factors (Borman & Overman, 2004; Brown, 2008; Lee, Winfield, & Wilson, 1991; Masten, 1994). Protective factors are demonstrated to be more complex than simply the absences of risk; they are the specific behaviors and circumstances that decrease the likelihood of negative outcomes (Rutter, 1987). These studies confirm protective factors or processes - individual or environmental characteristics that enhance one's ability to resist stressful events - promote the adaptation and competence in the lives of Black students (Spencer, 2006, 2008a, 2008b).

Many conceptualizations of protective and risk factors are influenced by researcher-developed and researcher-driven criteria (Skinner, Zimmer-Gembeck, & Connell, 1998). In other words, a protective or risk factor is defined as such by the researcher, usually at the onset of the study, and then "verified" by the research participants (Benard, 1991). It has been generally established in the resilience literature that protective factors are traditionally defined by mainstream characteristics (e.g., middle class and higher SES, two-parent household, generational wealth, White skin) because they lessen the likelihood of negative consequences and increase the probability of positive outcomes. However, accurately identifying the protective factors for Blacks, particularly low-income Blacks, has been problematic at best (Brown, 2008; Harris-Britt, Valrie, Kurtz-Costes, & Rowley, 2007; Miller & MacIntosh, 1999).

Phenomenological Variant of Ecological Systems Theory

Newer models provide a better understanding of resiliency in ways that contribute to understanding the diverse ways that Black adolescents and families cope with challenges. One of these models, the *Phenomenological Variant of Ecological Systems Theory (PVEST)*, considers identity development processes and context settings (Bronfenbrenner, 1995; Spencer, Dupree, & Hartmann, 1997; Spencer, 2006). PVEST examines the interaction of environmental context and identity development, and starts from the presumption that an individual's perceptions of their environment and experiences are crucial to gaining an understanding of the experiences and responses of Black students (Spencer, 2006). The PVEST's underlying assumption is that Black students often face additional sources of stress inside and outside the classroom, as they often receive negative or mixed messages about appropriate belief systems and cultural capital (Lee, Spencer & Harpalani, 2003).

The PVEST incorporates five major phases in its examination of environment and identity. These stages include: individual risk and protective factors, net environmental stresses and supports, adaptive and maladaptive coping mechanisms, emergent identities, and life stage outcomes (Markstrom-Adams & Spencer, 1995; Spencer, 2006).

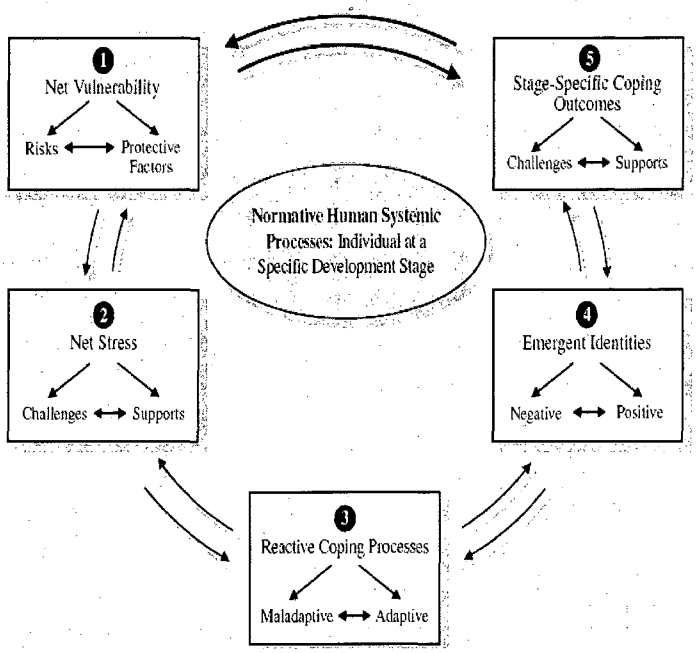


Figure 2.1
Phenomenological Variant of Ecological Systems Theory

- *Net vulnerability level* represents the balance between risk and protective factors.
- *Net stress engagement level* represents the balance between perceived challenges and supports.
- *Reactive coping strategies* include a balance between maladaptive and adaptive solutions to perceived problems or challenges.
- *Stable coping strategies* represent coping strategies that are neither necessarily reactive nor problem-specific and may be either positive or negative and manifested as internalized emergent identities.
- *Life-stage coping outcomes* represents the diverse outcomes (both positive and negative) that can be experienced based on coping behaviors and emergent identities that, in turn, influence coping behaviors.

The PVEST helped to fortify my understanding of resilience, particularly because of its combined focus on culture as lived experience within the dynamics of the environment and its complexities, and how students make sense of their experiences. Spencer's (1995, 1999, 2006) work on resiliency revealed that unique and seldom explored environmental factors (e.g., social bias) not only matter in the lives of Black students but also require specific protective (coping) strategies in response to an individual's particular social status (Spencer & Harpalani, 2004).

Race Matters, Identity Matters, and Resilience Matters

Results of research on African American students in mathematics and engineering education demonstrate the underlying notions that race, identity, and resilience matters.

Race matters in how most Black students either identify themselves or are identified and treated by others (Gosa & Alexander, 2007). Identity matters in the how the students respond to issues of race and racism in their lives. In particular, identity matters with regard to how the students characterize their experiences in mathematics learning and participation, inside and outside the classroom. Resilience matters because the ways in which the students exhibit strength and perseverance play a role in their racial and mathematics identities.

Research on resilience revealed that Blackness can be experienced as a challenge or source of support, or both (Spencer, 20006; Winfield, 1991). Also revealed are the ways in which identity may interplay with awareness of stereotyped views held by others about Blacks.

The resilience of Black students is a reminder that too often researchers, while acknowledging the support and resources available to White students, discount the support and resources available to Black students. This study adds to the research that investigates the high-achievement of Black students, their construction of identity (racial and mathematics), and their cognition-dependent interpretation that creates meaning making.

CHAPTER 3

METHODS

In this chapter, I provide a detailed description of the research methods that I used for understanding the experiences of a select group of high-achieving Black mathematics and engineering students. This chapter begins with an overview of the participants, including recruiting methods and profiles of the twenty-three students. Then, I describe the methods used in this study: counter-narrative storytelling, an augmented form of the life story interview format, and case study analysis. In addition, I describe the coding and analysis techniques employed. To complement the qualitative interview data, I will discuss my use of the Multidimensional Inventory of Black Identity (MIBI), which allowed for an in-depth understanding of the respondents' racial identities.

Recruitment and Selection of Participants

I recruited 23 participants for this study from Browning University, Soho University, Medium University, and Ivy University. The participants were solicited via informational flyers posted on campus bulletin boards, during the recruiting period of July 2006 to July 2007. The respondents were all juniors, seniors, and graduate students and attended one of these four universities, which are located within one large Midwestern city and its surrounding suburbs.

Programs serving Black students were targeted for focused attention. Contact was made with the directors of minority engineering and mathematics programs and Honors Colleges, and teachers who lectured in junior, senior, and graduate level mathematics and engineering classes, requesting their permission to give a five-minute presentation about my study. I also spoke to particular organizations such as the National Society of Black Engineers (NSBE) and the Black Student Union (BSU). I requested that interested participants be available for two

interviews and, as an incentive for the interview portion of this study, each participant who completed the interviewing process received ten dollars.

Students interested in participating in this study were given contact information (phone numbers and an email address), and those who called or emailed were given detailed information about the study. Participants were made fully aware that they would be video and audio recorded and were asked to sign an informed consent form to obtain permission to record participants as well as each participant's consent for the public use of his/her video or audiotape. Issues of confidentiality were discussed, and though confidentiality was assured, anonymity was not, as subject faces would be visible on the videotapes. I changed all identifying information and had personal information stored in locked cabinets in my home office. During the interview, I assured the students that they need not answer any question that made them feel uncomfortable, and informed participants that video recording was optional. The participants, after acknowledging that confidentiality and risk procedures were explained, signed the consent form. A copy of this form was given to all participants for their records. This form also explained how I would use and present the data. Copies of the consent form and telephone script are located in the Appendices (Appendices B and C, respectively).

The selection criteria included Black or African American self-identification, along with standard measures of high academic and mathematics achievement. The criteria for undergraduate participation were unofficial college transcripts that indicated the participants' junior or senior status, mathematics or engineering major, maintenance of at least a 2.8 grade point average (on a 4.0 scale) in mathematics courses, successful completion of at least 10 mathematics and/or engineering-related courses, and an A or B in at least five of those classes. The overall grade point averages (GPA) of the students in this study ranged from 2.8 to 4.4, with a median of 3.4 (several students received over 4.0 by enrolling in graduate level courses).

In determining the minimum GPA to be considered high-achieving in engineering and mathematics, I compared college level engineering and mathematics student scholarship requirement criteria. Many engineering and mathematics scholarships agencies and organizations offer academic scholarship for juniors, seniors, and graduate students at 2.8, even 2.5 GPA (University of South Florida- College of Engineering, 2008). The value of a 2.8 grade point average in engineering and mathematics appears to be comparable to a 3.0 or higher in non-science, technology, engineering, and mathematics (STEM) fields (Smith, & Schumacher, 2005). For graduate students, the criteria were recipient of a Bachelors of Science degree in mathematics or engineering and pursuit of graduate-level mathematics and engineering degrees.

The 23 participants, 14 males and 9 females, ranged in age from 19 to 45, with the median age being 26.3 years. Of the 23 students, six, four males and two females, were attending graduate school. Three of the six graduate students were in masters programs, and the other three students were in PhD-level mathematics or engineering programs (see Table I).

University and college level teaching was the intended career goal for four of the six graduate students. Jamal's career goal is to be a mathematics test engineer and Albert desired to go back to his home country of Nigeria and work. Four of the six graduate students were U.S.-born-Blacks. Albert and Jamal are non-U.S.-born-Blacks. Albert relocated to the United States from Nigeria for both his undergraduate and graduate education. Jamal was born outside the U.S. and was raised and educated in Ghana for his K-16 schooling (see Table 2).

Name[1]	Age	Year in Grad School	Gender	Undergrad Major	Major	Intended Career	Degree Sought
Jimmy	25	1st	Male	Mechanical Engineer	Bio-medical Engineering	University Professor	PhD
Valerie	24	1st	Female	Mathematics	Biochemical Engineering	College Professor	PhD
Wisdom	26	2nd	Female	Bio-medical Engineering	Bio-medical Engineering	Professor or Business Owner	MS
Rob	40	5th	Male	Mathematics	Mathematics	Professor	PhD
Jamal	28	2nd	Male	Computer Engineering	Engineering/ Computer Science	Math Test Engineer	MS
Albert	25	2nd	Male	Electrical Engineering	Applied Mathematics	Unknown type of work in Nigeria	MS

TABLE I
Graduate Student Participants

Wisdom and Rob indicated they were raised in low socio-economic status households, where mothers served as sole caregiver and provider. Valerie, Jamal, and Jimmy indicated they were reared in middle socio-economic status households, and Albert chose not to answer this question regarding his family socio-economic status.

Name	Ethnicity	Parents/ Guardians	College	Family Income Levels /Yearly
Jimmy	African American	Mother / Father	Ivy	$80 - 99 K
Valerie	Black	Mother / Father	Ivy	$60 - 79 K
Wisdom	Black	Mother	Medium	Less than $20 K
Rob	Black	Mother	Soho	$20 - 39K
Jamal	Nigerian	Mother / Father	Medium	$40 - 59 K
Albert	Kenyan	Mother / Father	Medium	No answer

TABLE II
Graduate Student Demographic Information

[1] All identifying information has been changed.

The seventeen undergraduate student participants consisted of ten males and seven females. All of the undergraduate students were enrolled in school full-time, except for Gladis, who was enrolled part-time and worked full-time for the transit system. Five of the students were mathematics majors and the rest where engineering majors (civil, chemical, computer, electrical, and mechanical engineering).

Name	Age	Gender	College	Major	Intended Career	Intended Grad Major
Cory	20	Male	Soho	Applied Math	Math Professor	Math
Tiffany	24	Female	Medium	Electrical Engineering	Undecided	Engineering Education
Denise	45	Female	Browning	Applied Math	Entrepreneur	No Grad School
Damon	29	Male	Browning	Electrical Engineering	Electrical Engineer	No Grad School
Gladis	40	Female	Browning	Applied Math	College Professor	Math
Anita	25	Female	Medium	Electrical Engineering	Lobbyist or Teacher	Energy Policy
Supo	19	Male	Medium	Mechanical Engineering	Engineer	Mechanical or Electrical Engineering
Mike	26	Male	Soho	Mechanical Engineering	Fulltime Pastor	Divinity
Bobby	22	Male	Medium	Industrial Engineering	Business Owner	MBA
Lisa	26	Female	Browning	Math	Undecided	Applied Math and Physics
Rich	23	Male	Soho	Chemical Engineering	Operations	MBA
Feya	24	Female	Medium	Civil Engineering	Math Professor	Civil Engineering or Math
Chrissy	19	Female	Ivy	Electrical Engineering	EE or Management	Electrical Engineering
Olu	20	Male	Ivy	Electrical Engineering	Management	Management
Chalmus	21	Male	Ivy	Mechanical Engineering	Entrepreneur	MBA
Calvin	21	Male	Ivy	Civil Engineering	Eng planner	Civil Engineering or Transportation
Hakeem	39	Male	Browning	Math	Teacher	No Grad School

TABLE III
Undergraduate Student Participants

All except three of the undergraduate students planned to enroll in graduate school. The undergraduate respondents had family income levels that ranged from less than twenty thousand to over one-hundred thousand dollars a year. The intended careers of these students also varied widely, with teacher/professor, entrepreneur, and engineers topping the list. Four of the sixteen students started careers before entering college and ten of the participants worked part-time, while attending school full-time. Before enrolling in college, Denise was a flight attendant, Damon served in the Untied States Marines, Wisdom taught at a charter school, and Feya was an administrative assistant. Eight of the undergraduate students had been in college at least six years; one student had been in and out of college for over twenty years. Of the five students who changed their majors in college, three switched between engineering and mathematics disciplines. Lisa was a former elementary education major, and Tiffany entered college undecided.

Table IV highlights how these students changed their majors but not their ambitions to pursue mathematics and engineering. Tiffany entered college undecided because her high school guidance counselor told her that she was unlikely to succeed in such a difficult major as engineering and advised her just to take some introductory classes to see where it would go. Cory and Gladis entered college as engineering majors because they were skeptical about the career options and job opportunities in mathematics, but decided to follow their passion.

Name	College	Major Entering College	Current College Major
Cory	Soho	Mechanical Engineering	Applied Mathematics
Tiffany	Medium	Undecided	Electrical Engineering
Gladis	Browning	Electrical Engineering	Applied Math
Bobby	Medium	Computer Engineering	Industrial Engineering
Lisa	Browning	Elementary Education	Mathematics

Table IV
Undergraduate Students Who Changed Their College Majors

Nine of the 17 undergraduate students were raised in two-parent households. Those 9 students were raised in families with income levels greater than forty-thousand a year. Five students -Denise, Gladis, Anita, Lisa, and Feya- were raised in single-parent, female-headed households whose yearly income levels did not exceed forty-thousand a year. Rich and Tiffany were raised in non-traditional, multi-caregiver households (See Table V).

Name	Age	Year(s) In School	Ethnicity	Raised with Parents/ Guardians	Family Income Level
Cory	20	3rd	Black	Mother & Father	No answer
Tiffany	24	7th	Black	Mother & Grandmother	$40-59K
Denise	45	10th	Black	Mother	Less than $20K
Damon	29	7th	Black	Mother & Father	$60 - 79K
Gladis	40	20th	Black	Mother	$20-39K
Anita	25	7th	Black	Mother	Less than $20K
Supo	19	4th	Nigerian	Mother & Father	$40-59K
Mike	26	5th	African American	Mother & Father	No answer
Bobby	22	6th	African American	Mother & Father	Over $100K
Lisa	26	6th	Mexican & Black	Mother	$40-59K
Rich	23	4th	African American	Aunt & Grandmother	$40-59K
Feya	24	7th	Hebrew & Black	Mother	$40-59K
Chrissy	19	3rd	Black	Grandmother	over $100K
Olu	20	3rd	African American & Nigerian	Grandmother	no answer
Chalmus	21	3rd	African American	Grandmother	$80-$99K
Calvin	21	3rd	Black	Grandmother	$40-59K
Hakeem	39	5th	Black	No answer	No answer

TABLE V
Undergraduate Participant Demographic Information

Overview of College Institutions

The institutions selected for this study were chosen because their respective social contexts reflected differing pressures and supports for these Black mathematics and engineering learners. Medium University and Browning University are institutions located in a large urban city in the Midwest and predominantly serve the local populations. Soho University, although

located on the south side of a large urban Midwest city, serves a large international population. Ivy University is located in an affluent suburb and attracts an international student population due to its academic reputation.

Looking at the mathematics curriculum at all four universities, the average number of mathematics courses required for a Bachelor of Science in Mathematics is fifteen. For the engineering programs, all three universities require at least five mathematics courses, and an average of 14 engineering courses. The choice of using these four institutions was valuable because their respective social contexts reflected differing pressures and supports that might bear upon the students' identities as Black mathematics and engineering learners.

Medium University

Medium University is primarily a commuter campus and has a student population between twenty and thirty thousand. About 90 percent of students are residents of the state, and Medium boasts of an over 50 % freshman cohort of African Americans, Latinos, and Asian students. However, less than 9% of Medium's student population is Black. Almost half of Medium's population is made up of Asian and Latino students. In the fall of 2005, Medium's College of Engineering had an undergraduate enrollment of 1, 550, and less than 10% were African American. That same year, mathematics had an undergraduate enrollment of 106 and 5 were listed as African American. Between spring 2004 and spring 2007, Medium University enrolled approximately 320 Black undergraduate students out of a total 4,500 undergraduate engineering students per year; on average less than 25 of the 340 undergraduate engineering graduates were Black.

Soho University

The total undergraduate enrollment a little over 2,000 is almost a thousand less than the total graduate enrollment of approximately 3,000. For 2005, out of 204 junior level engineering majors, only 11 were African American. In that same year, in the senior engineering class of 265 students, there were only 13 African American students. In that same year, Soho graduated 9 Black engineering undergraduates of a total of 203 engineering undergraduate students. The College of Engineering currently employees one Black assistant professor and employees no associate or full professors. Soho University has a fairly strong reputation in science and technology fields, and boasts a 98% placement rating into jobs or graduate schools within three months of graduation. The 2008 undergraduate class was 70% male and 30% female, which highlights their continued gender inequities. Soho's tuition of around $27,000 has increased steadily over the past five years, yet they claim that 97% of students receive some type of financial aid.

Browning College

Browning has a 2/3 engineering program, which means that the first two years are spent at studying engineering at Browning and the reminding three years are completed at a partner university. Browning University is a significant producer of city public elementary and high school teachers and therefore plays a unique role in the public education of Black students. Browning, whose enrollment is over 7,000, has an African American student population a little over 80%. Browning has played a significant role in the production of African American mathematics degree recipients. Browning has a significant number of Bachelor of Science African American mathematics degree graduates. Over 75% of the graduates from 2003 through 2007 were African American, graduating less than five percent of their undergraduate-level

African American mathematics students in 2003 to graduating 45% and 22.5%, on average, of its 2006 and 2007 enrollees, respectively.

Ivy University

Ivy University is located in an affluent Midwestern suburb and attracts an international student population due to its academic reputation. Furthermore, Ivy is a highly selective institution in comparison to Soho, Browning, and Medium Universities, thereby adding an additional variation to this study. Ivy's undergraduate student population is a little over 8,000 is considered one of leading universities in the United States. The majority of Ivy's student population is White, and Black enrollment dropped from approximately 10% in 1980 to 5% in 2004. The high tuition cost of this private institution, around $35,000, creates an additional variance of class to this study, as many students who attend this University are of middle to upper socioeconomic class.

Ivy graduates only one female for every two males with Bachelor of Science degrees. The ratio of Whites to Blacks is 15 to 1 for undergraduate engineering degrees.

Between 2003 and 2007, African Americans were less than 3% of the overall graduate level engineering students at Ivy University. During the same time period, Ivy graduated a total of 5 Black engineering PhDs and Ivy's Mathematics Department is a non-producer of graduate level mathematics degree recipients. Out of an average of 41 students in the mathematics graduate-level program, Ivy has graduated no Black mathematics masters or PhD-level graduates, between the years of 2002 and 2008.

Case Study Approach

I employed a case study approach to gather more detailed data on 3 of the 23 students in this study. Case study is an ideal methodology for this study because a holistic in-depth investigation of the participants was desired. Case studies have been used in varied investigations, particularly in sociological and psychological studies, but increasingly, in education (Stake, 2000; Yin, 1994).

Another appealing aspect of case study research is that it allows consideration of not just the voice and perspective of the research participants, but also a more holistic understanding of racialized systems in action (Feagin, Orum, & Sjoberg, 1990). Mills' (1997, 1998) considered philosophy as a racialized discipline. He stated that social formations, such as education, have a "normal" dynamics and contain a racial component. Racialized systems of action refer to sets of interrelated activities engaged in by the actors in a racialized situation.

Researchers who employ case study and interview techniques understand that there exists a complex relationship between what "really happens" in a person's life and how the person chooses to remember and understand their experiences (McAdams, Reynolds, Lewis, Patten, & Bowman, 1991; White, 2007). Interviewing centers on objective facts as well as delving into perceptions, values, personal motivations, and so on. Therefore, it includes the subjective, value-oriented interpretations of the storyteller.

Counter-narrative and Life Story Interviews

Most qualitative research reflects a *phenomenological* perspective (Glesne, 1999), which considers human beings the center and determinants of world events. I used a phenomenological approach because it generates information about individuals' perceptions of the world and the meanings that they make of events (Strauss & Corbin, 2000). Such an

approach required direct participation in the discovery of the meanings constructed by participants; a sharing of the study participants' experience of; and a describing of what the participants have been through, how they have lived it, and the meanings they make of their shared knowledge (Rossman, 1999). Polkinghorne (1989) suggested that the researcher and readers of a phenomenological research study should be able to say, "I understand better what it is like for someone to experience that" (p. 46). Researchers who depend solely on quantitative methods may be unable to interpret human feelings, emotions, perceptions, and attitudes; and quantitative studies may not fully represent the participants in all their human complexity.

My choice to conduct interviews as the core of my methodological approach was fueled by a commitment to exploring the voices and experiences of Black students, and by a rich body of research literature that gives primacy to first-hand accounts of these students' experiences in mathematics (Berry, 2003; Martin, 2006a, 2006b; Moody, 2003; Nasir, 2000; Stinson, 1994). Counter-storytelling and life story interviews, in particular, were ideal methodologies for this study as they allowed for a holistic in-depth investigation of the participants (Stake, 1995).

The semi-structured, open-ended interview was the primary method of data collection used in this study (Corbin & Strauss, 1990). As Yin (1998) points out, with semi-structured interviews, the interviewer has a clear list of issues to be addressed and questions to be answered. However, within this format, interviews were conducted with flexibility, allowing the interviewee to develop ideas determine the order of topics covered. I used words that were somewhat familiar to the participants during the interview, so that they could respond to something they understood. Interviewee responses provided in-depth characterizations on the salience of race, racial identity, resilience, and racialized mathematics experiences in the lives of these students.

The interviews were conducted at the desired location of the participants, most often their homes or dormitories, coffee shops that had space for privacy, workplaces, and school libraries. Some second interviews were conducted at my house. Thus, privacy was established in settings that were familiar to the respondents. The initial interviews of all 23 students ranged from 49 minutes to 2 hours. The length of the six case study interviews, which required an additional interview, ranged in from 57 minutes to an hour and 45 minutes. The interviews created a space for respondents to articulate in their own words the barriers and supports toward K-12 and college success.

For the interviews in this study, all participants were asked to give an in-depth overview of their lives and educational experiences. In addition, all respondents provided an overview of the main "chapters" of his or her life as a learner of mathematics and engineering, detailing the influential stages of their development. I also captured reflections on their experiences as Blacks, allowing them to frame what it means to "be Black" more generally, and what it means to "be Black" within the specific contexts of mathematics and engineering learning and participation. I especially focused on any significant happenings with mathematics and engineering and interpretations of any experiences where race was a factor. The students were asked to describe challenges in relation to the achievement of mathematics and engineering success. The interviews included open-ended questions such as:

- At what age did you realize that mathematics or engineering was going to be an integral part of your life? What steps did you take to ensure this vision?
- Did you have role models or mentors in your life that helped you to embrace mathematics or engineering? If so, what type of messages did they instill and how have you internalized or acted on those messages?
- Is there a personal or social significance in achieving success in mathematics or engineering?

- Is your mathematics or engineering success a way for you to improve your life's circumstances?
- Can you share any experiences where racism played a major role within your experiences inside the mathematics or engineering classroom or related contexts? How did you feel/respond?
- Many people assume that engineering and mathematics are "White" or "Asian" fields. What are your feelings about this stereotype and have there been any instances where you have had to deal with it? How did you deal with it?
- What type of individuals surround you or do you wish to attract when engaging in mathematics and engineering learning? How does this differ from your network outside the mathematics and engineering classroom?

Interviews were transcribed verbatim. Transcription was prompt, which allowed for follow-up interviews as needed and adjustments to the interview protocol. All video and voice recordings were given a code to insure that subjects cannot be identified directly or indirectly.

Counter-storytelling

Critical Race Theory's method of *counter-storytelling*, sometimes called *counter-narrative methodology* (Delgado & Stefanic, 2001; Solórzano & Yosso, 2002b; Witherell & Noddings, 1991), allowed me to be fully engaged in the stories of how these Black mathematics and engineering students "achieve in mathematics and engineering while Black." Delgado and Stefanic (2001) define *counter-storytelling* as a method of explaining individual and collective experiences that "aims to cast doubt on the validity of accepted premises or myths, especially ones held by the majority" (p. 144). Thus counter-storytelling is a tool not only for unveiling the experiences of marginalized people that are often muted but also for challenging the dominant stories of those in power that are regarded as normative (Delgado, 1995; Solóranzo & Ornelas, 2004; Solóranzo & Yosso, 2002a, 2002b). Recent research by Martin (2006b), Berry (2003, 2005), and Stinson

(2004) are examples of studies in mathematics education that have incorporated counter-narratives.

Life Story Interview

I complemented the counter-narrative methodology with the *life story* interview approach (McAdams, 2008a, 2008b; McAdams, Josselson, & Lieblich, 2006), which required the students talk in depth about various stages of their lives, to better understand how race, racial identity and resiliency shaped their educational and social experiences over time (Grace, 1999). McAdams et al. (2001) defines life story as "an individual's internalized narrative rendering of his or her life in time, entailing the reconstructed past, perceived present, and anticipated future" (p. 475). McAdams (2008a, 2008b) asserts that people provide their lives with unity and purpose by constructing internalized and evolving narratives of the self. The story is the best available structure that persons have for integrating and making sense of life in time. Life stories function to establish identity as opposed to establishing traits, motives, values, etc. (McAdams, 2008b). Because life stories function to establish identity, allowing individuals to make sense of their lives at a particular moment, this method aided my efforts to understand the identities of my participants.

McAdams's (2001, 2008a, 2008b) asserts that people provide their lives with unity and purpose by constructing internalized and evolving narratives of the self. The idea that identity is a life story resonates with a number of important themes in developmental, cognitive, personality, and cultural psychology. This internalized evolving story allows individuals to reconstruct the past, perceive the present, and anticipate the future. Those interviewed were involved in reconstructing their stories, which may have been embellished, altered, etc. Therefore, life story interviews serve as a representation of the truth, yet go considerably

beyond the facts by constructing stories that make sense to them as the respondents make sense of the world.

Video Recording and Editing

The videotaping of the interviews proved to be a powerful medium in conveying the images of Black students engaged in re-constructing their identities and the events that led to their academic success. It allowed for repeated viewing and analysis of situations repeatedly which was helpful in getting both a general and intimate sense of the students. The use of digital video allowed for recording of participants, analysis of their words and actions, clipping of relevant segments, and organization of those segments into a series of frames and codes, keeping the images and/or voice of the participants intact (Kellehear, 1993), including gestures, intonation, pauses, and inflections. It reduced the impact that the transcription process has on the content, because the transcription process itself flattens the potentially rich, three-dimensional quality of the original footage into a two-dimensional text format.

Videotaping of interactions seemed to present no difficulty for the participants. Those who were initially nervous soon forgot the camera's presence. This is consistent with research showing that videotaping seems to have little impact on anxiety and responsiveness for the respondents (Weimann, 1981).

Coding and Analysis of Interview Data

The interview data was central to this study (Chenail, 1994) and called for a coding and categorizing of the data. During the coding process, the students not only cited experiences of racism but also the strategies they employed to maintain or develop success in engineering or mathematics, as well as other statements that spoke to resilience in academic and life obstacles.

Analysis of the interview data incorporated an iterative coding scheme. This process of sorting and resorting, coding and recoding of data led to emergent categories of meaning. In analyzing the data, themes were identified that emerged in the transcripts of the 23 counter-stories.

Once all the interviews were coded, data was initially categorized by theme. After which data was scanned "for categories of phenomena and relationships among the categories" (Goetz & LeCompte, 1981, p. 57). Some initial themes to emerge were: *seeks out/takes advantage of opportunities to grow; does/pursues what interests her/him; accepts challenges; rejects self- hatred; seeks out places, spaces, individuals, or groups that provide a sense of belongingness; employs strategies to deal with racism; succeeds in proving stereotypes wrong; achieves realistic self-confidence; works toward succeed to serve as a role model; rejects stereotypes about math; rejects racial stereotypes; rejects stereotypes about women; embodying parents' ideology of excellent in mathematics; perseveres despite obstacles; enters competitions to test self/abilities; picks/develops own criteria by which to judge himself/herself; develops personalized strategies for ensuring success in math and engineering; develops/seeks like-minded friendships; adheres to some standards of the white culture*. These 19 categories served as the initial category set, and were assigned initially short names.

These thematic categories, however, proved to be just a starting point and were later rearranged. I realized I did not have 19 simple categories, but rather multiple categories with subcategories, requiring ongoing revisions. After numerous revisions, categories and subcategories revealed different strategies that led to success for these students. Coding proceeded as follows: Codes were identified, and quotes that reflected the codes in individual interviews were connected. For example, one code that recurred throughout the interviews was the presence of racial stereotypes. So, for every interview that discussed how the student has felt about and reacted to racial stereotypes, the quotes were coded as follows:

Rob Identifies the Stereotype of Blacks Being Inferior in Mathematics
2P:[00:04:11.24] Well, you know we are generally perceived as being the worst at intellectual things, especially mathematics. And what's fascinating about that is, if you think about it you know, mathematics in the wider culture is perceived as the hardest subject and all subjects essentially are derived from mathematics whether it's theoretical physics or whatever.

Multidimensional Inventory of Black Identity (MIBI)

The Multidimensional Inventory of Black Identity (MIBI) (Sellers et al., 1997) was used to assess racial identity among the participants. This 56-item inventory is comprised of three scales that measure *centrality of race, racial ideology, and regard.* The ideology scale consists of four subscales (*Nationalist, Assimilation, Minority, and Humanist*), and the regard scale consists of two subscales (Private Regard and Public Regard). A 7-point Likert type response scale consists of rating items with responses ranging from 1 (strongly disagree) to 7 (strongly agree).

Sellers et al. (1998) define racial identity in African Americans as "the significance and qualitative meaning that individuals attribute to their membership within the Black racial group within their self-concepts" (p. 23). Thus, they ask the questions: "How important is race in the individual's perception of self?" and "What does it mean to be a member of this racial group?"

The questions on the MIBI rest on four underlying assumptions. First, they assume that identities are situationally different as well as stable. Second, the MIBI recognizes that race is one of a number of identities that are hierarchically ordered and malleable for African Americans. The third assumption is that people are the best judge of their own racial identity. Fourth, in developing and refining the MIBI, Sellers et al. (1997, 1998) are more interested in the status of a person's racial identity (more like a snapshot in time), rather than examining the development of their racial identity.

Salience refers to the extent to which a person's race is a relevant part of her/his self-concept at a particular moment in time. Salience is concerned with the specific event as the level of

analysis. It is highly sensitive to both the context of a situation as well as the person's proclivity to define herself/himself in terms of race (i.e., centrality). Salience is a dynamic aspect of racial identity by which the other three dimensions (centrality, ideology, and regard) influence the way a person experiences a particular event. When racial identity is made salient, an individual's ideology and regard influences their understanding and the ways they respond to certain behaviors. Salience cannot be operationalized because it is so situationally specific.

Centrality refers to the extent to which a person normatively defines herself/himself with regard to race. Centrality is an indicator of whether race is a core part of an individual's self-concept. There are six questions on the MIBI that capture the centrality component. Three of those six questions are:

- In general, being Black is an important part of my self-image.
- My destiny is tied to the destiny of other Black people.
- I have a strong sense of belongingness to Black people.

The *ideology* dimension of the MIBI represents a person's philosophy on how African Americans should engage in cultural, social, political, and even academic activities within dominant group contexts. Sellers et al. (1998) present four ideological philosophies: assimilationist, nationalist, oppressed minority, and humanist. The assimilationist perspective focuses on the compatibility of African Americans with a normalized definition of the rest of the society: typically heterosexual, White, male, and middle class. A person with an assimilationistic perspective attempts to enter mainstream culture and believes that African Americans should work within the system to produce change. The nationalistic perspective incorporates views of uniqueness and distinction from other racial groups and is demonstrated by a deep regard for African American culture. Individuals' nationalistic philosophies develop into a deep appreciation and preference for African American social environments. The

oppressed minority ideology represents a broader perspective of oppression and recognizes its effects on all ethnic minority groups (Sellers et al., 1998). Individuals endorsing the oppressed minority ideology embrace the similarities that exist between oppression of African Americans and other minority groups. The humanist perspective focuses on similarities of all humans and not necessarily the physical distinctions between groups. Those endorsing the humanistic perspective view race as an insignificant factor to how they live their lives. Although some individuals can be categorized as possessing one ideology predominantly, it is likely that most people hold a variety of ideological philosophies that vary across areas of functioning. I did not use this measure for my study because of the inconsistencies between the identities they discussed in their interviews and the MIBI results.

The final dimension, *regard*, refers to a person's affective and evaluative judgment of his/her race. The regard dimension consists of a private and a public component. Private regard refers to the extent to which individuals feel positively or negatively towards African Americans and their membership in that group. There are six statements on the MIBI that deal with private regard, three of them are:

- Overall, Blacks are considered good by others.
- In general, others respect Black people.
- In general, other groups view Blacks in a positive manner.

On the other hand, public regard refers to the extent to which individuals feel that others view African Americans positively or negatively. There are six questions on the MIBI that relate to public regard. Two of those six statements are:

- I am happy that I am Black.
- I feel that Blacks have made major accomplishments and advancements.

When using a holistic measure to assess racial identity, I recognized that socially constructed attributes like race have been proven to impact the development of Black students (Allen & Jewell, 1995; Maton, Hrabowski, & Greif, 1998). Therefore, mathematical development among Black students benefited from the consideration of racial identity. In addition to the interviews and case study analysis, the participants' responses from the MIBI allowed me to determine any variance between the MIBI results and the interview data. Therefore, the MIBI complemented the qualitative phase of this study, which allowed me to investigate variance between the two methods.

CHAPTER 4

A MODEL FOR TRAJECTORIES OF RESILIENCE AMONG SUCCESSFUL BLACK MATHEMATICS AND ENGINEERING STUDENTS

In this chapter, I present a bi-directional model that maps two trajectories of resilience for the study participants: a fragile form of resilience and a robust form of resilience. This data-driven model was created by systematically collecting and analyzing the interviews, the MIBI, researcher notes, and the demographic questionnaire data. While no model fully represents the complexity of human experiences, I believe this model serves to illuminate (1) the negotiation of racial and mathematics identities, (2) racialized experiences in mathematics learning and participation, and (3) strategies used by the participants to sustain high academic achievement. My model adds to the knowledge on resilience by suggesting that developing resilience is crucial to the mathematics and engineering achievement of Black college students. Before presenting my model, I will briefly re-introduce Spencer's Phenomenological Variant of Ecological Systems Theory model, which provided me a better understanding of diverse ways that Black adolescents and students cope with challenges and risk factors.

Snapshot of the Phenomenological Variant of Ecological Systems Theory

The Phenomenological Variant of Ecological Systems Theory (PVEST) model considers identity development processes and context settings (Spencer, Dupree, & Hartmann, 1997; Spencer et al., 2006). PVEST's underlying assumption is that African American students often face additional sources of stress inside and outside the classroom, as they often receive negative or mixed messages about appropriate belief systems and cultural capital (Lee, Spencer, Harpalani, 2003).

PVEST incorporates five major phases in its examination of environment and identity. These stages include: individual risk and protective factors, net environmental stresses and supports, adaptive and maladaptive coping mechanisms, emergent identities, and life stage outcomes (Spencer & Markstrom-Adams, 1990; Spencer, 2006). The model is represented in Figure 4.1 below:

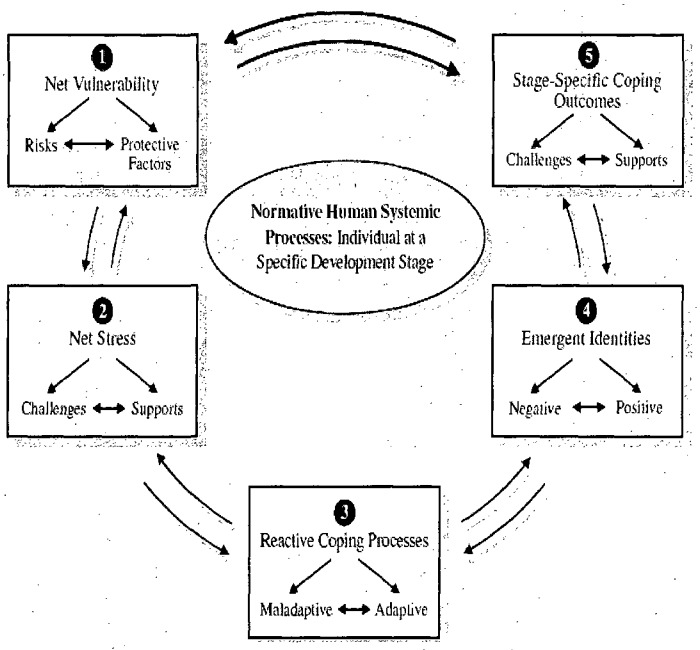


Figure 4.1
Phenomenological Variant of Ecological Systems Theory

Spencer's (1995, 1999, 2006) work on resiliency revealed that unique and seldom explored environmental factors (i.e., social bias) not only matter in the lives of African American students but also require specific protective (coping) responses in response to an individual's particular social status (Spencer, 2006). Building on Anthony's (1974) theory of resilience, Spencer (2006) identified four potential theoretical links between vulnerability status (i.e., balance between

risk-factor levels and protective-factor presence) and specific achievement and identity outcomes for diverse groups of low-economic-status adolescent youths. Those outcomes are depicted in Figure 4.2 below:

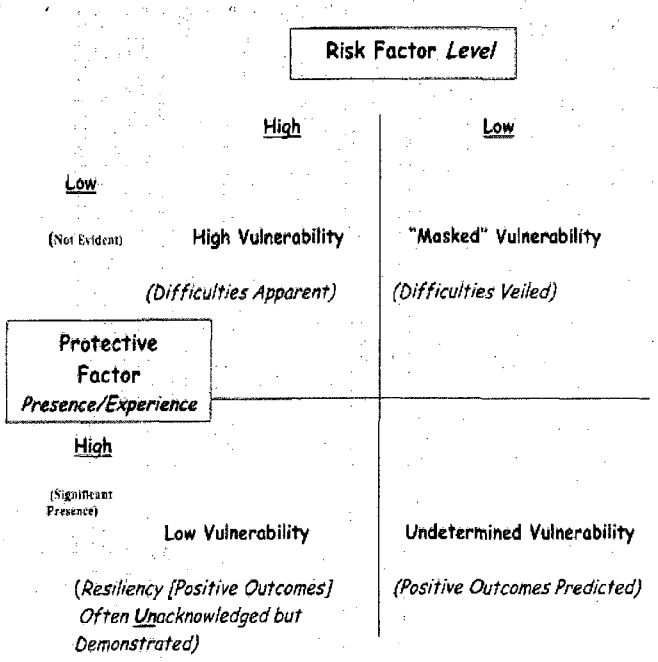


Figure 4.2
PVEST-Linked Vulnerability Level and Resiliency Prediction Dual Axis Model

According to Spencer (2006), Black youth with a high level of risk factors and a low level of family, environment, and instructional support, for example, are highly vulnerable and have a greater probability of negative outcomes (*High Vulnerability*). While students with low risk levels and support levels may seem better protected, a challenge may reveal their failure to develop coping mechanisms, giving them *"Masked" Vulnerability.* Adolescents with high levels of risk but also high levels of support are expected to have low vulnerability and be more

resilient (*Low Vulnerability*), but those with low risk and high support have been largely untested, and therefore have *Undetermined Vulnerability*.

Robust and Fragile Forms of Resilience

A major contribution of this dissertation is the unpacking of *Low Vulnerability*, resiliency. My data shows that there are two trajectories of resilience that high-achieving Black students navigate a *robust* form of resilience and a *fragile* form (See Figure 4.3).

My model acknowledges the developmental process of human development understanding that individuals grow significantly during the middle school and high school years (Spencer, 1999). The model also recognizes the complexity and diversity of Black students' characteristics, in part shaped by society's views. The fragile form of resilience incorporates strategies for mathematics and engineering success that are primarily motivated by proving Black academic inferiority wrong, by way of high achievement. This is a fragile form of resilience because the students were operating through internalizing negative racial stereotypes and were preoccupied with defending themselves against these external and damaging criteria. The fragile form of resilience was dominant mostly in the students' K-12 experiences, although the students had varying degrees of incorporation of the robust form of resilience from elementary years to their final years in school. The robust form of resilience replaces to the fragile form of resilience by evolving to incorporate self-defined reasons and motivations to pursue mathematics and engineering. The students were no longer driven to succeed by racial stereotypes and to make their parents happy. They sought out individuals, groups, and places that affirmed their identities as high-achieving Black mathematics and engineering learners. In the robust form of resilience the respondents' long term goals were to serve as role models and mentors to encourage and teach other Black students to engage in mathematics and

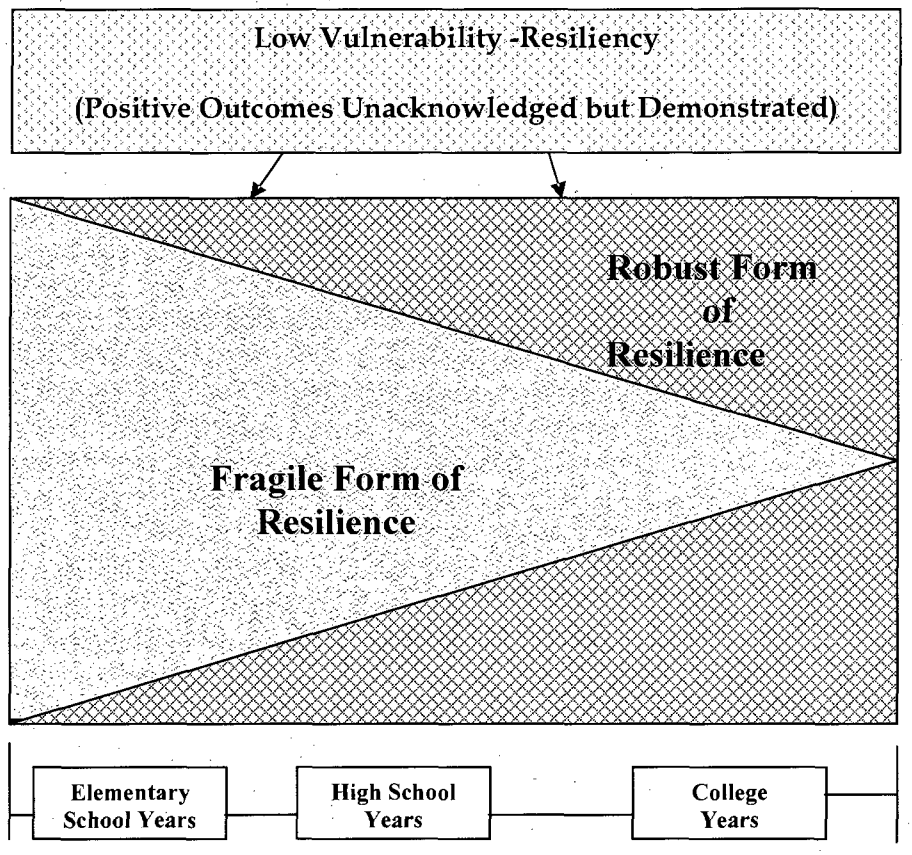


Figure 4.3
Resiliency Expansion Model

engineering. The robust form of resilience became dominant between the end of high school for some students and the beginning of college for most others. Racialized incidents caused the students to continue to use some strategies and motivations within the fragile form of resilience. Yet, once students transitioned to mainly operating under the robust condition their outcomes for racial and mathematics identities remained robust despite the use of fragile motivations and strategies.

The two forms of resilience imply that resilience is developmental and occurs over time. Developmental researchers have emphasized the limitations of a "one model fits all" approach to studying Black students (Garcia-Coll et al., 1996; Simons et al., 2002). The "'one model fits all" conversation exposes the dangers of race-comparative research that normalizes the behaviors of an entire racial group, nonetheless it detracts from models that account for intra-group diversity within racial groups (Garcia-Coll et al., 1996). Given the variability of Black students, high-achieving mathematics and engineering students was an ideal sample to create a specific model that highlights insights not readily available from traditional models. My model moves beyond the race-comparative models that have largely resulted in two theories used to explain Blacks over the last 160 years: the genetically deficient model (Herrnstein & Murray, 1994; Jensen, 1969) and the culturally deficient model (Senn, 1975; McWhorter, 2000), which couches Black development in terms of deficiencies and deviances. As opposed to focusing on negative developmental outcomes or compare Black students in unfavorable measures to White students, my model delineates cultural difference (not deviance) and academic success from the voices and experiences of the participants themselves, who are the best informants in retelling and making assessments about their own lives (McAdams, 2008a). Lastly, this model does not frame these students as "ideal" or free from exhibiting negative attitudes or dispositions, as a few of the respondents expressed very prejudice views about particular populations of Blacks (read low-income and undereducated).

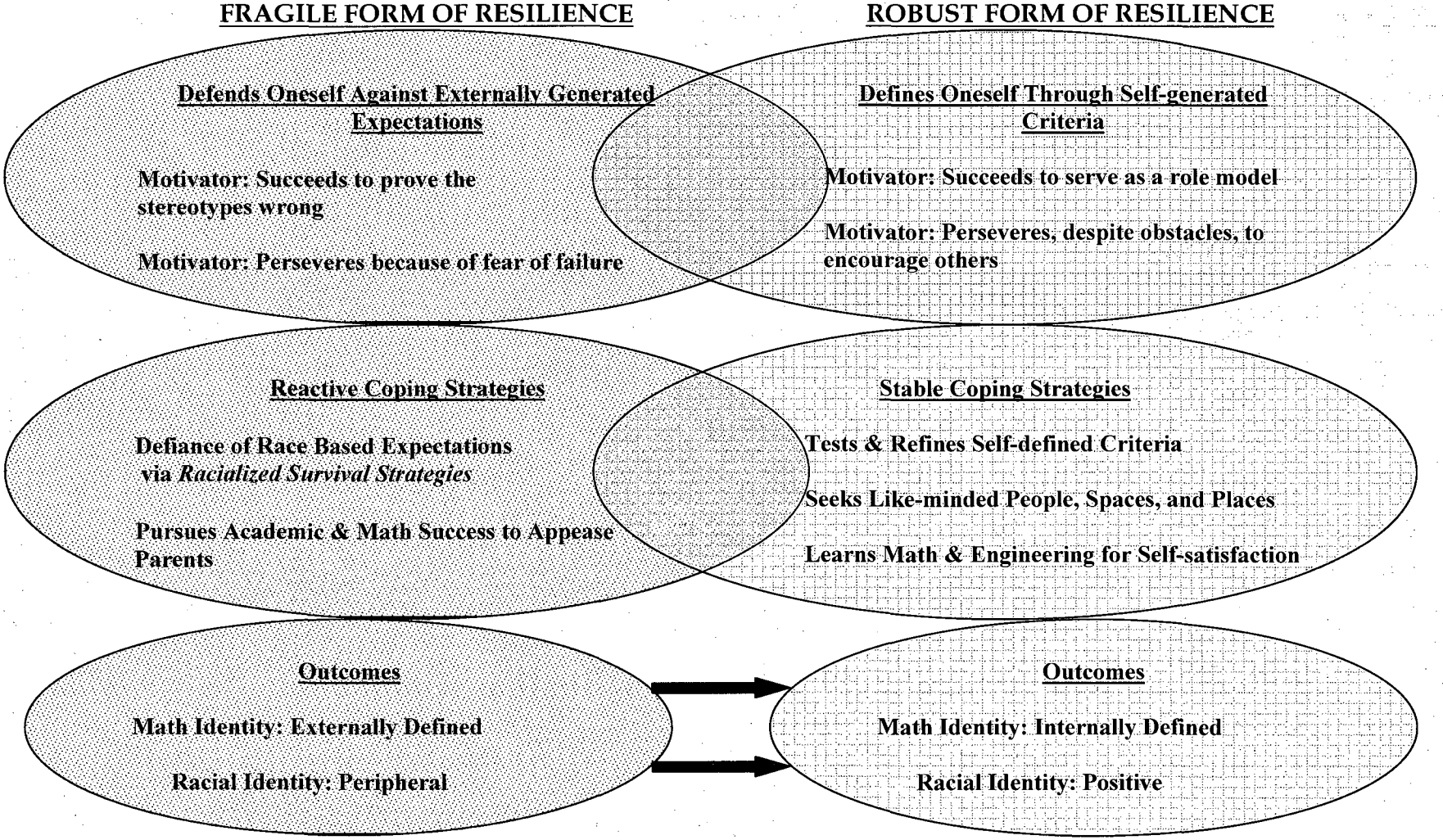
Figures 4.4 and 4.5 offers a glimpse into the developmental processes of these students' lives and relates their mathematics and engineering experiences. The students' experiences do not happen uniformly and the model does not apply to all the students, although all the students are represented in certain components of the model. Additionally, the outcomes (mathematical and racial) do not necessarily indicate the end of their resilience trajectories; they represent their

outcomes at the time of study. However, speculative predictions and judgments can be accessed based on the identity and human development process of these adult participants. There are two paths of resilience indicated in Figures 4.4., but I am not suggesting that the students got to this point of their development and academic success through these simple paths alone. The model attempts to integrate the students' experiences with explicit attention to their ecological circumstances (e.g. the persuasive influence of racial stereotypes). The specificity of the population (academically successful Black mathematics and engineering upper classmen and graduate level students) contributes to my developmental model that conceptualizes the human development processes, experiences, and outcomes for the respondents.

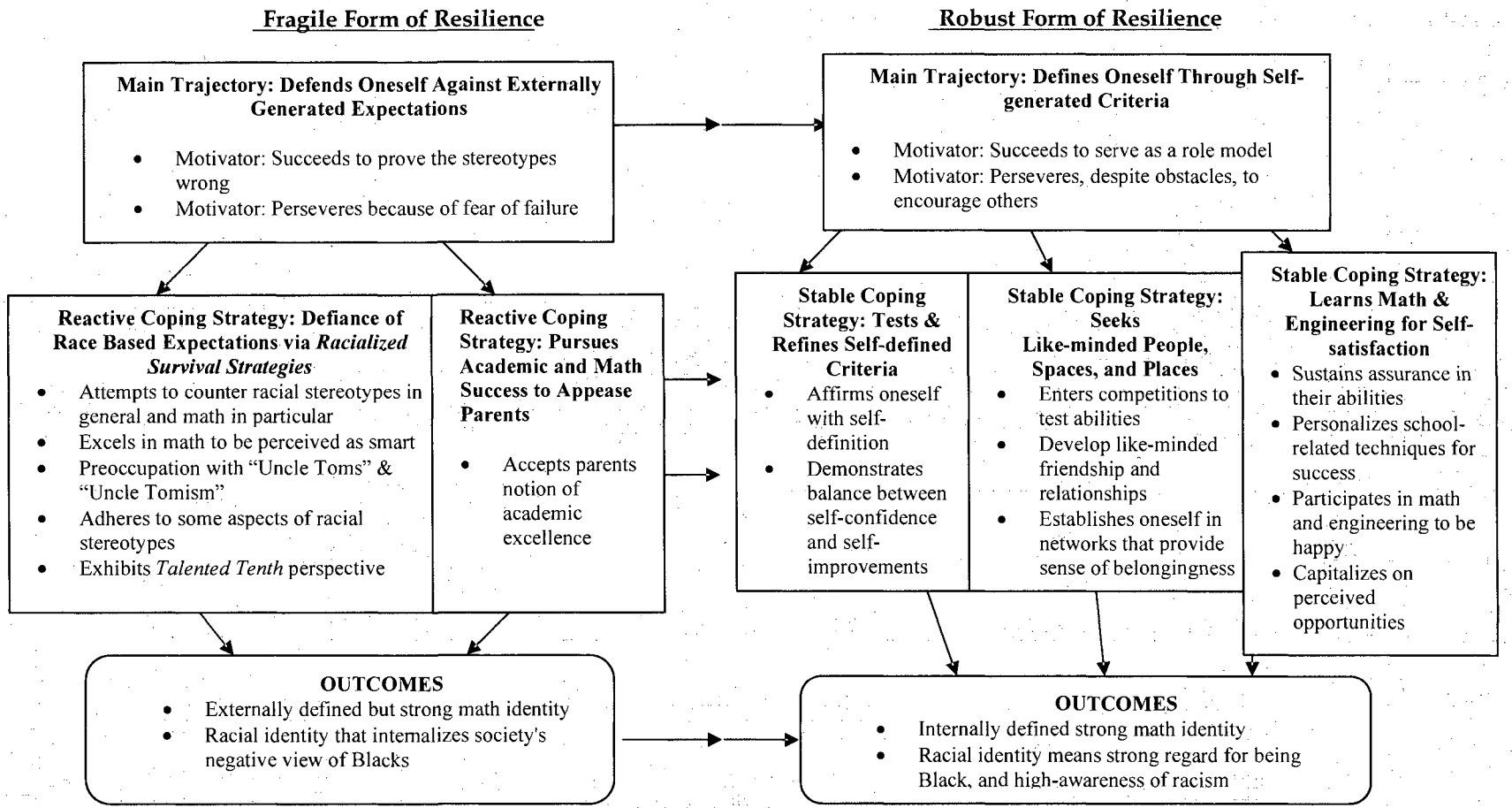
Figure 4.4 provides a visual explanation of the fragile and robust forms of resilience, in general terms. This model contains three different processes that take place and sometimes overlap within the two form of resilience. Figure 4.4 is positioned as a model that may be generalizable for high-achieving Black students, majoring in mathematics and engineering. Figure 4.5 breaks down resiliency for these twenty-three students. Figure 4.5 offers the specific strategies employed by the 23 respondents in the study, thereby offering more specificity to the model presented in Figure 4.4.

The fragile form of resilience is embedded within the robust form of resilience. All of the students in this study began their educational journeys through the fragile form of resilience. Eventually, over time and experience, the students created strategies and behaviors that expand to more of a robust form of resilience. Twenty-two of the twenty-three students made the transition form the fragile form of resilience to the more robust form of resilience.

By using cross-case analysis, I demonstrated the substance of my model of resilience and elaborated on the themes and strategies characterizing each form of resilience. A substantive model accounts for how the respondents' situate their struggles for mathematics and



Model for Trajectories of Resilience Among Successful Black Mathematics and Engineering Students
Figure 4.4



Model for Trajectories of Resilience Among These 23 Successful Black Mathematics and Engineering Students
Figure 4.5

engineering success within the larger context of *being Black*. The model accounts for how the participants' exercised a variance between a more resistive stance to racial stereotypes and experiences in the robust form of resilience and a more accommodating posture in the fragile form of resilience, based on beliefs that mathematics and engineering success can used to prove the stereotypes types wrong (fragile) or change the conditions of their lives and serve as role models for students that look like them (robust).

The robust form of resilience is an extension of the fragile form of resilience and from time to time the respondents still react emotionally and defensively to racial stereotypes in ways that characterize the fragile path of resilience.

Fragile Form of Resilience

Main Trajectory: Defends Oneself Against Externally Generated Criteria

Within the fragile resilience trajectory, the main motivation to succeed for the respondents, besides the desire for high achievement, is to prove racial stereotypes wrong. The students felt obligated to stand up against racial stereotypes by demonstrating their mathematics and engineering success, thereby showing themselves and other Blacks in a positive light. As the respondents reflected on their early school experiences, they optimistically thought that demonstrating intellectual excellence would erase the low expectations placed on them by the U.S. schooling systems and society. The respondents expressed disappointment and dismay for not being able to eradicate the stereotypical ways in which their intellect was challenged and ridiculed. As a result, the students would at times experience extended periods of despair but without losing belief in their own abilities to succeed in mathematics and engineering.

Motivator: Succeeds to Prove the Stereotype Wrong

The students are faced with lowered expectations and they respond by attempting to prove the racial stereotypes about Blacks and mathematics wrong (Steele & Aronson, 1998). Engineering is not prevalent in this motivator because proving the racial stereotypes wrong was usually enacted during elementary and middle school years, before engineering was introduced to the participants. Through high achievement outcomes, the students were determined to erase not the racial stereotypes inflicted upon them but other forms of racism present in their mathematics classrooms. The outcome of attempting to prove the stereotype wrong was mathematics success, but proving the stereotype wrong was harder than the students predicted (Steele & Aronson, 1995). The students did find temporary solace in small victories where they felt they won over a mathematics teacher or a group of peers. Their small victories often resulted in the students being referred to as un-reproducible anomalies and "freaks of nature," which minimized the respondents intended results of proving the stereotype wrong. Additionally, even if the students obtain the prestigious title of "smart," they were still subjected to the other stereotypes associated with the Black race (i.e., lazy, a thief, drug addict, poor, promiscuous, smart but still an "affirmative action student," etc.).

Motivator: Perseveres Because of Fear of Failure

Students were also forced to deal with a multitude of life experiences in which mathematics achievement became a necessary part of escaping the failure and despair found in their communities. However, their perseverance in the face of challenging life conditions was enacted to "stay afloat" for survival. The participants used their school

success as a way to survive trauma resulting often from the complex consequences of racism. The respondents reacted to community despair and devastation by using mathematics achievement as a means of escape.

To use their mathematics and engineering achievements as a resource to rid themselves of an overwhelming fear of failure without any consideration of the one's own self-definition is a weak form of success. For example, seven of the students did not even realize how much they actually liked mathematics or engineering until college because the felt pressured by society and family to pursue the discipline as a way out and a way up. Similarly, three of the students in this study have decided that they do not want to pursue mathematics and engineering as a full-time career because they "don't like it enough." Albert, Mike, and Denise felt pressured to major in mathematics and engineering just because they were good at it. They received numerous messages, which they read as demands to do mathematics, whether they liked it or not. Conversely, all of the students who affirmed that they liked or loved mathematics and engineering aspire toward mathematics and engineering-based careers.

Reactive Coping Strategy: Defiance of Race-Based Expectations via Racialized Survival Strategies

The respondents did not believe in, and adamantly rejected, the racial stereotypes that exist in mainstream culture about the academic achievement of African Americans. The fact that these racial stereotypes are so pervasive caused a great deal of emotional distress. Due to the increased number of racial stereotypes that exist for Black college students in mathematics and engineering, they were bombarded by a wide assortment of discrimination. For example, students reported being called an affirmative action

case, White students who seemed in uncomfortable "awe" of their classroom intellect, not being able to find a hairdresser/barber within her/his college town that "does Black hair," no "all-Black" radio stations, etc. In response, the students attempted to defy the stereotypes (Helms, 1995; Lee, 2008), first through achievement, then when that did not work, through a host of other strategies, initiated to deflect racial bias. I refer to these methods as *racialized survival strategies* and they served as a means to manage racism in school and in life. As they continued achieve in mathematics and engineering, the students failed to defy the stereotypes, and their pre-occupation with proving themselves caused weariness and distress.

Racialized survival strategies were a set of intricate strategic actions to circumvent historical, deeply embedded, persistent, societal problems. The respondents developed a racial toolkit to help protect them from the damage that *racial battle fatigue* inflicts. Smith (2004) introduced the concept of racial battle fatigue to explain the stress associated with being Black in predominately White schooling environments. Smith affirms that the marginalization of students of color at predominantly White universities causes racial tension for students of color at those universities by many different means, including racial micro-aggressions and racial stereotypes, which are racial assaults that attack the character of students of color.

The students felt the need to perform in ways that were contrary to who they were and took on an identity that was not a true representation of who they were. They engaged in purposeful acts of acting Black to prove they could be the stereotypical definition of being Black and still be high achievers. Some students engaged in acting White and overemphasized certain traits deemed correct by the mainstream standards, while demonstrating their achievement.

Three respondents either looked down on other Black students for not "pulling themselves up" and "not taking advantage of the plethora of opportunities" to achieve academic excellence, or focused on personal choice and responsibilities for sustaining success. As for the other 20 respondents, their adaptive responses to racial stereotypes led to academic success but not without significant damage to the respondents' psychological well-being. No matter how hard the respondents tried to debunk the myths of Black intellectual inferiority, they were still often perceived and thought of as second-class students.

The students gravitated towards mathematics to mirror the stereotype that deemed high-mathematics achievers as being smart in most of subjects and highly intelligent. The students played into that stereotypes and showcased their mathematics outcomes. They determined that academic success inside a particular mathematics and engineering classroom came with prestige and privilege, enjoyed by only the students deemed as smart. Yet, as always, with the change of classrooms, schools, teachers, academic programs, tutors, and school administrative personnel, the students are once again faced with enduring stability of racial stereotypes and had to re-climb the ladder of mathematics and engineering high expectations.

Reactive Coping Strategy: Pursues Academic and Math Success to Appease Parents

The students felt pressure by their parents to pursue academic excellence and particularly to do well in mathematics. Their parents and guardians had passed onto their children the importance of getting good grades and test scores. In some households academic excellence was part of the family's expectations, whereas in other households academic and mathematics achievements was handsomely rewarded and

acknowledged. Even parents who themselves were not able to help their children in their mathematics work stressed the need for being mathematically literate. The parents taught to their children that mathematics success can help them navigate through a school system of injustice, racism, and poverty. What the parents did not account for was their children's natural curiosity and interest in mathematics. Although the students accepted their parent notions of mathematics and academic excellence, they did it without much thought of their own fundamental happiness, which made learning mathematics by this approach a fragile form of resilience.

As the respondents came to understand the dynamics behind how they were being identified in racially stereotypical language, they slowly resisted the constant motivation to prove their intellect. The students navigated their way through the mathematics and engineering pipeline, were confident in their academic abilities, and did not feel the need to prove themselves to everybody else. The drive for mathematics and engineering achievement against the backdrop of proving one's worth was no longer stimulating and they began to examine more personal reasons to sustain their achievements. As the students searched for additional motivations to sustain their mathematics and engineering achievement they discovered a surprise ally: themselves.

Robust Form of Resilience

Main Trajectory: Defines Oneself Through Self-Generated Criteria

During high school, a more robust form of resilience began to manifest in the students, one that includes defining oneself by criteria that was self-developed and psychologically nurturing. The participants revised their strategies in ways that honor their identities, all the while functioning at a high level within the educational milieu. As

they persisted in their education, particularly during their late high school and early college years, they were able to skillfully navigate success without accepting self-limiting or self-doubting external criteria. They understood that responding to externally generated standards of excellence is, at times, necessary, yet the students carried out those standards in concert with their own self-imposed standards. They developed a new sense of purpose, which began with a better understanding and self appreciation but ultimately led to achieving for a purpose larger than themselves. The participants resisted simplistic notions of "acting White" or "acting Black" and even "acting smart" and opted to live according to what best suited them (Spencer, Noll & Stoltzfus, & Harpalani, 2001).

Motivator: Succeeds to Serve as a Role Model

An African proverb says, "It takes an entire village to raise a child," but who will raise the village? The students in this study overwhelmingly proclaim, "I will." Not wanting future generations of Black students to endure their hardships, 20 of the 23 participants plan to serve as a role models and teachers of mathematics or engineering. Having experienced despair from teachers and a system that does not value their culture nor appreciate their intellect, these students wanted to be "that Black teacher." "That Black teacher" is that one great teacher who 5 of the 23 students enjoyed in their K-12 experiences, and the other respondents wish they had. "That Black teacher" is, first and foremost, Black and can relate to their experiences as Black students. "That Black teacher" is ideally a mathematics teacher, but for sure an inspiring teacher who can instill in his or her students the importance of believing in themselves and how to manage racism and succeed in spite of it. Four students desired to play a larger role in

the mathematics and engineering education of Black students by creating schools geared toward those majors or starting businesses to employ other high-achieving Black mathematics and engineering students.

Motivator: Perseveres, Despite Obstacles, to Encourage Others

The students were inspired to persevere through their personal and academic, not merely circumvent their fear of failure, but to inspire future generations of Black mathematics and engineering students, their families, and communities. The respondents expressed a deep sense of empathy for the next generation of Black students. They were well aware of how racism works to limit opportunities in mathematics and engineering for Black students. The participants saw virtue in helping other Blacks, who have similar hardships, overcome those to achieve academic excellence. The students' reasons for achievement went beyond personal success to include a collective responsibility to serve Black students.

Stable Coping Strategy: Tests and Refines Self-Defined Criteria

This journey to self-discovery started with trying out different self-defined strategies and then testing and tweaking those strategies in encouraging ways. The students aggressively created or took advantage of opportunities to grow academically and personally, particularly in their discipline of mathematics or engineering.

Social scientists have long been puzzled about why Black students seem to maintain high aspirations, even in cases where their own past performances make these aspirations unwarranted (van Laar, 2000). In contrast to "unrealistic optimism" theories, the respondents possessed the type of self-confidence that fueled their mathematics and

engineering achievement. This confidence allowed them to take risks and enjoy hard-fought victories. The respondents readily admitted to their mistakes and vowed to learn for them. The participants believed that there is a relationship between self-confidence and self-improvement, and their mathematics and engineering achievement.

Stable Coping Strategy: Seeks Like-Minded People, Spaces, and Places

The respondents cultivated better understandings and appreciation of themselves and others like them, in ways that exhibited resistance to traditional forms of intellectual legitimacy and affirmed their individual self-expression. The respondents' developed more definitive forms of self-expressions.

Some respondents joined Black organizations that demonstrate personal commitment and individual involvement in community service projects. As active members of organizations like Black fraternities and sororities, National Society of Black Engineers, they became personally involved in community service projects, and became more involved in the needs and issues that are relevant to the survival of the African-American community. Additionally, these Black-owned organizations offered the respondents support for those seeking solace from racism, racial tension, and being a minority at predominately White institutions. Other students chose organizations that provide a sense of belonging, a sense of a family away from home. The students develop best in environments where they feel valued, protected, accepted, and socially connected with people with similar backgrounds and similar interests and ideas. Like-minded friendships increased the respondents' sense of belonging, purpose and self-worth, and acted as a buffer against life's hardships.

More often than not, their emotional security came from friends, social and academic organizations and networks. The participants utilized predominately Black support networks because they provided students with a sense of belonging and acceptance typically unavailable anywhere else in their lives.

Stable Coping Strategy: Learns Math and Engineering for Self-satisfaction

In this more robust form of resilience, the respondents found strength from their mathematics knowledge. The respondents hold strong opinions and deeply held beliefs about their ability to participate and perform effectively in mathematics contexts and to use mathematics to change the conditions of their lives. The resilience shifts from learning mathematics and engineering to be perceived as smart to learning mathematics and engineering to pursue one's own happiness and inner contentment.

Even during times of academic and life turmoil, the respondents' mathematics and engineering grades stayed above average and so did their desire to pursue mathematics and engineering. The students continued to engage in mathematics and engineering and the more they learned, the stronger their desire was to follow their passions for the fields.

The students were able to sustain assurance in their abilities largely due to their belief that they are proficient in mathematics because of innate or natural ability. Accepting this notion of instinctive mathematical aptitude allowed the participants to be intrinsically motivated to pursue mathematics and engineering, no matter how difficult these disciplines became. Perceiving their mathematics abilities as "a gift" meant to the respondents that disappointments and difficulties in mathematics and engineering were merely temporary setbacks and success was the only viable option. Nineteen of the

twenty-three students were highly confident about their abilities in mathematics and engineering. Even in the midst of C minuses, a fourth attempt at completing a three-page math solution, cramming the night before three midterms, etc., they continued to be self-assured and poised in the face of surmounting challenges. It appears that quite possibly an extra dose of assertiveness and high-self esteem may be required to defend one's self against the trials and tribulations that come with being Black and a high-achiever in mathematics and engineering. Yet, as confident as the respondents were, that confidence did not overshadow their abilities to assess and check any unproductive characteristics (e. g., lack of academic identity, lack of effort in certain mandatory mathematics classes).

Outcomes for Mathematics Identity and Racial Identity

The outcomes for mathematics identity and racial identity are characterized differently for the two forms of resilience. In the fragile form of resilience, the participants mathematics identity, defined as internalized psychological beliefs about one's ability to perform within mathematical contexts, and their perceptions about the nature and importance of mathematics in one's life (Martin, 2006a), were externally driven. The students were motivated to achieve and thereby gained confidence and competencies in mathematics through their parents' pressure to excel and attempts to defy racial stereotypes and other forms of racial discrimination. Mathematics served more as a tool against oppression than a pursuit of knowledge for the sake of learning. The respondents' mathematics identities were less about their own intrinsic interests to pursue mathematics, and geared toward proving their intellectual abilities through the use of mathematics achievement outcomes.

Although data on the long-term impact of racial stereotypes on racial identity development and academic motivation is largely unexplored in the literature (Harpalani, 2007), the students' self-conceptions of *Blackness* were threatened due to way in which they perceived racial stereotypes under the fragile form of resilience. Feelings of anger, hostility, and social and educational anxiety led to an external methodology for acceptance, in which perceptions were dominated by mainstream conceptions of racial identity. In spite of their attempts to destigmatize themselves, efforts to disavow their imputed inferiority have not been successful. The majority of the students assume the behaviors and belief system dictated by the society. Although the students did not believe in the racist attitudes endemic to their environment, they reacted to them in ways that handicapped them mentally and emotionally, though not intellectually.

Navigating success under the robust form of resilience offered a self-fulfilling mathematics identity and a higher self-concept for *being Black,* as well as a higher awareness of racism and racialized situations.

Mathematics and racial identity outcomes in the model are not bi-directional. Once the students evolved from a fragile form of resilience to a robust one, their mathematics and racial identities were more fully developed and did not revert back to the mathematics and racial identity of the fragile form. Even when the participants' motivations and strategies operated within the form of fragile resilience, their mathematics and racial identities remains robust. I will further explore these differences in Chapters 5 and 6.

Chapter 5 explores the model of resilience via a cross-case analysis of all 23 participants. This cross-case analysis validates and substatiates key themes and strategies. Chapter 6 will outline three in-depth cases narratives of two graduate

students and one undergraduate student to provide life-story perspectives on these students' lives and mathematics and engineering trajectories. In-depth case study analysis was necessary to show the respondents' capacity to create meaning and self-reflection.

CHAPTER 5

RESILIENCE AMONG HIGH-ACHIEVING BLACK MATHEMATICS AND ENGINEERING STUDENTS: A CROSS-CASE ANALYSIS

> [We] typically do not hear the voices [or see the faces] of those who create living educational theories. (Hamilton & Pinnegar, 2000, p. 235)

The students profiled in this study succeeded, in part, through a complex interaction between two different forms of resilience, one fragile and one robust. In Chapter 4, I defined a fragile form of resilience as an externally driven path of achieving mathematics and engineering success. A robust form of resilience incorporates self-definition and an intrinsic path of achieving mathematics and engineering success.

The goal of this chapter is to examine both of these trajectories using cross-case analysis. Cross-case analysis is a research method used to examine a concept, theory, or a social process across multiple cases. Stake (1995) referred to cross-case analysis as a collective case study. By using cross-case analysis, I will demonstrate the substance of my model of resilience and elaborate on the themes and strategies characterized by each form of resilience.

Robust forms of resilience builds on the fragile forms as the students develop more self-initiated motivations and strategies to gain success. I contend that fragile forms of resilience are a developmental stage toward more robust, enduring forms of resilience. I restate that these two forms of resilience are not mutually exclusive paths of resilience (See Figure 5.1). The lines in Figure 5.1 represent the different stages of resilience that the 22 of the 23 students navigated within (one student continued to operate within the fragile from of resilience).

One student, Olu, a 20-year old senior electrical engineering major, is the only student whose primary motivations continue to revolve around proving the racial stereotypes are wrong. Olu admits that he has grown weary on the constant attention it takes to prove the stereotypes wrong in his field of electrical engineering and he opted to pursue a MBA in management. Olu will use his MBA to "to get as far away from engineering as possible."

A few of the 22 students used significant portions of the fragile form of resilience, while others rarely used the fragile form to navigate mathematics and engineering success. Most of the 22 students over time and experience developed toward a greater incorporation of robust for of resilience, which in turn decreased the usage of the fragile form of resilience. Some situations, the students noted, required operation of the fragile of resilience (e.g., answering all the questions during the first week of a new mathematics classes to prove that they belong their) but after the results were achieved, the majority of the students reverted back to mainly operating in the robust form of resilience.

The results show a pattern in which the majority of informants begin their educational journeys of mathematics and engineering (to a lesser extent) success by being preoccupied with negative racialized criteria, ideologies, and stereotypes that have been defined in our society to limit the achievement abilities of Black students in general, and mathematics in particular. The students developed and engaged in multiple strategies for coping with and resisting racial stereotypes (Helms, 1995; Taylor & Antony, 2000). The strategies employed were mostly fueled by proving their racial classification had no bearing on their mathematics and engineering achievement. As

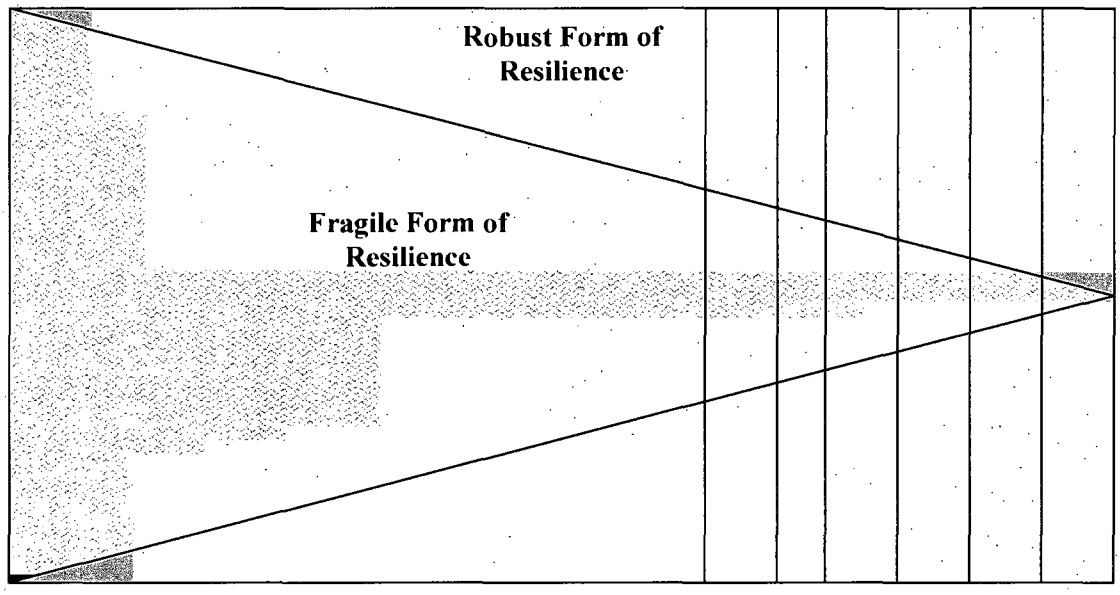


Figure 5.1
Resilience Trajectory for 22 of the 23 Participants at the age of the Study
Note: vertical lines represent of the different stages the students are operating within the resilience trajectory.

they matured in age the students grew by learning, adapting, developing, and engaging in their own criteria by which they chose to be defined. The interplay between operating within deficit-based motivations and self-generated motivations continues to exist for all of the participants except for one, but their college-age years incorporated more self-determined expectations.

The other 22 students are at different stages within a more robust form of resilience. Some students only spoke of incorporating a few elements of the robust trajectory in

addition to the fragile, whereas other students are utilizing most strategies in both the fragile and robust trajectories, but with a greater emphasis in the robust realm.

Name	Age	Gender	College	Grad Major	Intended Career	Graduate Level
Jimmy	25	Male	Ivy	Bio-medical Engineering	University Professor	PhD
Valerie	24	Female	Ivy	Biochemical Engineering	College Professor	PhD
Wisdom	26	Female	Medium	Bio-medical Engineering	Professor or Business Owner	MS
Rob	40	Male	Soho	Mathematics	Professor	PhD
Jamal	28	Male	Medium	Engineering Computer Science	Math Test Engineer	MS
Albert	25	Male	Medium	Applied Mathematics	Return to Nigeria for unspecified work	MS
Name	**Age**	**Gender**	**College**	**Major**	**Intended Career**	**Intended Grad Major**
Cory	20	Male	Soho	Applied Math	Math Professor	Math
Tiffany	24	Female	Medium	Electrical Engineering	Undecided	Engineering Education
Denise	45	Female	Browning	Applied Math	Entrepreneur	No Grad School
Damon	29	Male	Browning	Electrical Engineering	Electrical Engineer	No Grad School
Gladis	40	Female	Browning	Applied Math	College Professor	Math
Anita	25	Female	Medium	Electrical Engineering	Lobbyist or Teacher	Energy Policy
Supo	19	Male	Medium	Mechanical Engineering	Engineer	Mechanical or Electrical Engineering
Mike	26	Male	Soho	Mechanical Engineering	Fulltime Pastor	Divinity
Bobby	22	Male	Medium	Industrial Engineering	Business Owner	MBA
Lisa	26	Female	Browning	Math	Undecided	Applied Math and Physics
Rich	23	Male	Soho	Chemical Engineering	Entrepreneur	MBA
Feya	24	Female	Medium	Civil Engineering	Math Professor	Civil Engineering or Math
Chrissy	19	Female	Ivy	Electrical Engineering	Electrical Engineering or Management	Electrical Engineering
Olu	20	Male	Ivy	Electrical Engineering	Management	Management
Chalmus	21	Male	Ivy	Mechanical Engineering	Entrepreneur	MBA
Calvin	21	Male	Ivy	Civil Engineering	Eng planner	Civil Engineering or Transportation
Hakeem	39	Male	Browning	Math	Teacher	No Grad School

Table VI
All 23 Participants

In order to easily identify students I have reproduced the participant chart for review (See Table VI).

Findings Regarding the Students' Racial Identity

Because my model takes into account the ways that students invoke meanings for *being Black,* I briefly summarize my qualitative data from the MIBI to give a broad racial identity profile of the students.

Since socially constructed attributes like ethnicity and race have been proven to impact the development of African American students (Allen & Jewell, 1995; Maton, Hrabowski, & Greif, 1998), the development among Black students could not be properly studied without considering their racial identity. The MIBI suggests that student attitudes, beliefs, and worldviews play a significant role in shaping their identities as well as in constructing their academic and social environments (Sellers et al., 1997, 1998). The MIBI was helpful in illustrating the racial identity characteristics of the participants.

The MIBI also allowed me to determine any variance between the quantitative outcomes and the interview data. My study utilized the MIBI for descriptive purposes only due to the small participant sample size. All interview participants except for two took the MIBI. I present students' scores along the three dimensions of centrality, private regard, and public regard. The MIBI uses a 7-point Likert scale, ranging from 1 ("strongly disagree") to 7 ("strongly agree"). Results of the centrality, private regard, and public regard dimensions are displayed below in Table VII.

The first dimension measured Centrality. Centrality refers to the extent to which an individual normatively defines their racial group membership. Centrality is an indicator

of whether race is a core part of an individual's self-concept. The scores for the interview participants ranged from 3.13 to 6.38. The mean score was 4.77. Thus, the interview

Name	Centrality	Private Regard	Public Regard
Corey	3.88	6.83	3
Tiffany	5.13	6	2.33
Jim	6.13	6.5	3.33
Denise	4.88	6.83	3.33
Damon	6	6.67	1.83
Gladis	5.75	6.5	3.17
Valerie	5.13	6.33	4.33
Anita	6	6.83	3.33
Supo	3.13	5.83	3.33
Mike	5.38	6.5	2.5
Bobby	4.75	6	4
Lisa	5.38	5.33	4
Rich	4.5	6.67	3.83
Feya	3.38	6.17	3.17
Chrissy	3.5	5.17	3.5
Olu	4	6.67	5.17
Chalmus	4.88	6.83	3.33
Calvin	3.25	5.17	3.5
Rob	4.5	5.17	1.5
Jamal	3.25	6.67	2.5
Wisdom	6.38	7	2.33
Mean	4.54	6.27	3.21
ST DEV	1.03	0.60	0.85

ST DEV: Standard Deviation

TABLE VII
Results for Multidimensional Inventory of Black Identity

participants had above average perceptions of Black self-concept being significant to their overall identity. The students were engaged in high mathematics and engineering

achievement which were all above average (3.00), although there was considerable variance.

The next dimension measured by the MIBI was Regard. Regard is related to how negatively or positively an individual views her/his race, personally and from the perspective of out-group individuals. The subscale scores for Private Regard ranged from 5.17 to 7.00. The mean score was 6.46. Thus, this group, overall, had a positive view of their race and a positive view of the African American community. The students felt good about themselves as Black individuals. The Public Regard subscale scores were lower. They ranged from 1.50 to 5.17, with a mean score of 3.23. Thus, the participants had more negative perceptions about how others view Black people. Since both public and private regard deal with the question "What does it mean to be Black?", Blackness for the participants incorporated feeling positive about being Black and toward other Black people, while being highly aware of the negative ways in which Blacks are judged.

The MIBI results offer a partial challenge to findings which suggest that students who have high centrality, low public regard, and but high private regard excel the most in school achievement outcomes (Rowley, 1997). My results show that students did possess two of the three characteristics, high private regard and low public regard, but the participants' centrality varied widely, demonstrating the extent to which an individual defines race had varying significance to their mathematics and engineering achievement outcomes.

The variability between the interviews and the MIBI was evident in the centrality results. There were some individuals in the study (Bobby and Supo) who appeared to have stronger centrality results. The variability may be partly explained by the participants' need to appear race neutral at the beginning of the interview. As the

interview continued, participants felt much more comfortable discussing issues of race and its relationship to their identities. Additionally, Jim's interview responses suggest that he should have a low centrality score but his score was a 6.13 out of 7.00. Although most literature suggests that greater centrality makes individuals more attuned to racism (Sellers, Caldwell, Schmeelk-Cone, & Zimmerman, 2003), the results of this study show that students of both high and medium levels of centrality were well positioned to cope with racism.

A majority of the students described a keen sense of race and racism, within the school system and beyond, and the informants' low public regard caused them to work twice as hard in order to achieve success. Their cognizance of race and racism allowed the students not to blame themselves for the consequences of discriminatory situations and to use their contempt of racial stereotypes as a motivation to work harder.

It is important to note that these results denote the students' current thinking about their racial identity. When providing retrospective accounts of what it has meant to *be Black*, over half of the students identify their racial identity according to how they thought Whites identified Black Americans. For example, they often questioned their academic abilities in relation to Whites, due to their lack of historical understanding of racial bias. The more the respondents learned about or experienced racial inequities the better they understood racism and their appreciation for being Black increased.

One speculative conclusion suggests that the students were socialized to incorporate race to analyze the world and its role in shaping their identities. Racial socialization is defined as the tasks Black parents and other Black care givers share in providing for their children and youth, which include the responsibility of raising physically and emotionally healthy children in a society in which being Black has negative connotations

(Miller, 1999; Thomas & Speght, 1999). The goal of most Black parents and care givers is to develop a positive self-concept in a negative and often hostile environment (Parham, 1993; Stevenson, 1994). Researchers have recognized that racial socialization may insulate Black students from racist and negative stereotypes and encourage them to persevere and be successful (Billingsley, 1992; Bowman & Howard, 1985; Spencer, Swanson & Cunningham, 1991).

Fragile Form of Resilience

The next section outlines the key themes characterizing the fragile form of resilience. Figure 5.1 highlights its key motivations, strategies, and outcomes. A fragile form of resilience indicates that success in mathematics and engineering was largely based on the students defending themselves against negative racial expectations of Blacks' ability to achieve in mathematics or to appease their parents' expectations of academic or mathematics excellence. The fragile form of resilience for the students appeared from the onset of their schooling up until their late high school/early college years. While this form of resilience takes places in elementary and high school, some of the students still utilized their fragile form of resilience in college.

The main strategy the respondents employed to navigate toward success was by attempting to defy negative racial stereotype by achieving in mathematics (engineering is not prevalent at this point of their academic careers). Buying into the negative statistics widely cited about the Black community (Jacob & Jordan, 1993; Jencks & Phillips, 1998), the students persevere in their fields out of fear of ending up undereducated and unemployed. Other strategies revolved around acting in ways that were counter to who they were. As a result, the respondents' mathematics identities

were well developed but with little internal or intrinsic growth. The students were fighting for the right to be accepted as intellectual equals, but it was a difficult uphill battle as they underestimated the power of stereotypes. Being judged intellectually on the basis the stereotype took a toll on the students' racial identity, particularly their conceptions of what is means to *be Black* (Steele & Aronson, 1998).

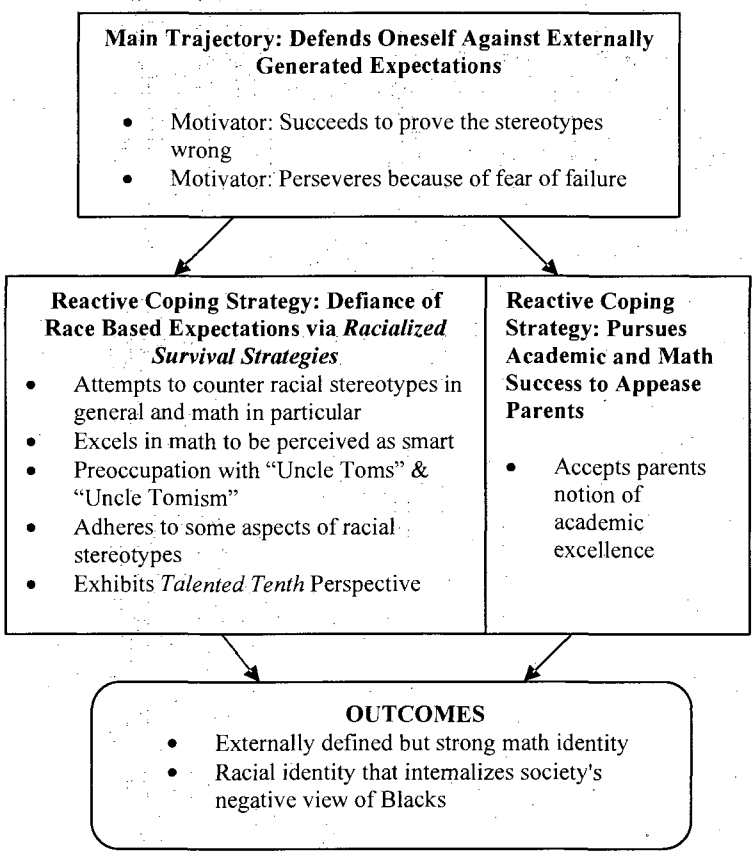


Figure 5.2
Fragile Form of Resilience

Main Trajectory: Defends Oneself Against Externally Generated Expectations

The respondents were operating within a defensive mode. Their reasons for taking up mathematics achievement were mostly driven not for their own sakes, but for reasons extrinsic to themselves. The students had two polarizing forces in which they achieved their mathematical pursuits: to prove their intellect to those who believed that Blacks were inferior in mathematics, and to meet their parents' expectations of academic excellence. During this time, the students spoke about meeting the expectations of others, without much attention to determining self-motivated ambitions for pursuing mathematics.

Motivator: Succeeds to Prove the Stereotype Wrong

The students learned, soon after they began their educational careers, the notion of Black inferiority and Black inferiority in mathematics. Whether already exhibiting success in mathematics prior to hearing those messages or having been introduced to mathematics achievement and racial stereotypes simultaneously, the respondents expressed deep contempt for racial stereotypes and other forms of discrimination revolving around Blacks and mathematics. After some contemplation, the students decided that their mission was to prove the stereotype wrong by achieving in mathematics. I consider this a fragile form of resilience because, even though they did not believe in the racial stereotypes, they still were driven by society's negative view of Blacks in mathematics. This drive provoked feelings of self-doubt and generated criteria by which to achieve, by which to fight against the stereotype. The respondents operated

within a set of motivators that depended on the acceptance of others, thus creating psychologically unhealthy conditions.

The *prove-them-wrong syndrome* was formulated by Moore, Madison-Colmore, and Smith (2003) to explain the academic and social experiences, attitudes, and personality characteristics of persistent African American males pursuing engineering degrees. They found that the prove-them-wrong syndrome was born out of "a psychological phenomenon that arises when the larger society projects an image of Black intellectual inferiority" (HBCU & Hammond, 1985). Albert explained that the notion of Black inferiority in mathematics was actually a driving force for him to achieve:

> It's definitely been a driving force of mine because I get a certain amount of satisfaction sometimes being the only African American in the class because, inside my own head, I don't even know if there's people in the class that think like this, but inside my own head I figure that there are people like, "Who's the Black kid at the back of the class? What's he doing here? He doesn't belong here." And like I said, it drives me forward knowing that there are people out there that think like that and I get to prove them all wrong—ha-ha. P:[00:25:15.00]

Albert explained even when no one uttered a word to him or gave him "What are you doing here?" glance, he still felt overwhelmed by the presence of the stereotype in most of his mathematics classrooms.

The respondents, who attended one of the historically White universities in the study, were often picked last to participate in mathematics and engineering labs or study groups. Clara was the only Black female in an engineering lab and being picked last made her score a 100 on the first lab exam:

> So nobody would pick me 'cause I'm like the only Black one, right? So as soon as the first exam would come back and I got 100 on mine, [and the other students in the class said] "Oh, how did you do that? How did you do that first problem? Here, could you show me how to—how did you get that beaker to—how did you set your lab up?" And I would just be looking like, "Yeah [laughing]." It

> would just be funny because I would be like, "Wow, these people are shallow." I mean I would just be looking like, "Well, whatever." I would help them, you know. If they asked me, I would help them. 'Cause you know I felt like that was a way for people to know that, you know, I am smart. P: [00:45:58.03]

Although Clara knew that her classmates' newfound interest in her was superficial, she still decided to help them because she said that assisting them further proved her smartness.

Teachers and school administrators' exhibit lowered expectations, provided fewer opportunities for exposure to Black engineering and mathematics role models, and offered less encouragement towards the enrollment of Blacks in advanced mathematics and engineering courses (Johnson & Kritsonis, 2006). The perception of lowered expectations had real consequences for the participants. Olu notes:

> I came to realize, like, these people [teachers and her peers] don't expect too much of me in this class, and so I've always had kind of like this idea even when I was younger, you know, if you tell me that I can't do something, then I want to prove to you that I can. And so for the rest of the time in all my upper-level classes, that was my goal. I might be the only Black person here [in her upper level engineering class], but I'm certainly not the dumbest. And so, like, I took that attitude from that point on in all my math classes, my physics classes, uh, my upper-level engineering classes, I was like, I sat at the front of the class. Like, I didn't come in and come to the back of the class. I sat at the front of the class. P: [00:25:33.17]

Olu is the only individual in this study who is still mainly driven by proving the notion of Black mathematics inferiority wrong, and he admits that his intention is to pursue a career in management as he considers it a less stressful and easier field in which to prove his intellect. The reactionary strategies may have temporarily deflected particular racially charged instances, but the students found themselves working too hard and too long to prove the stereotype wrong, and the rewards were few and not liberating.

Motivator: Perseveres Because of Fear of Failure

Fourteen of the students in this study faced a number of potentially debilitating conditions, which often predispose students to academic failure: lack of quality K-12 mathematics education; lack of strong academic identity (although all students possessed strong mathematics identity); raised in socio-economic poverty (city projects, "slum houses," teenage homelessness); early exposure to drugs; and physical, mental and sexual abuse. Although the students framed these as typically debilitating conditions, there was also a presence of protective factors that positively counteracted, or at least balanced out, the risk factors.

Lisa's time at school served not only as an outlet from the difficulties of her home life, but as an opportunity to engage in mathematics and science learning. Further, Lisa developed nurturing relationships with her teachers and they often facilitated the after school programs that she participated in. Lisa referred to school as the "happiest place to be." Because most of her negative experiences were outside of school, Lisa believed that the incorporation of these school supports caused her to grades to remain consistently above average. The use of school as a refuge from an unsupportive home environment led to Lisa to achievement in mathematics, but she described the lack of support at home led to an inability to make wise decisions regarding her life outside of school.

Tiffany and Damon achieved in school because of the fear that one day they would become one of the hopeless Black men and women they encountered in their "survive or die" type neighborhoods. Tiffany's old high school friend N'Tasha eventually dropped out of school and five years later was unemployed with two children. Instead of having a role model in mathematics and engineering as a source of motivation, Tiffany looked at N'Tasha's failure as a motivator to take a different path.

When I asked Damon why he decided to persist in engineering, he spoke of not ending up like a group of Black males in his neighborhood that live day by day. For these men a good day is when they can win five dollars in a street dice game and sleep on some clean sheets. Tiffany and Damon wanted to escape the daily sight of individuals and friends in their neighborhoods that they perceived as examples of failure.

Reactive Coping Strategy: Defiance of Race-Based Expectations via Racialized Survival Strategies

The majority of the students believe that occupational and social roles are predetermined in large part by society's racial hierarchy. Black youth, particularly Black male youth, are most often labeled as individuals who do not conform to culturally defined standards of normalcy, and they have not internalized the necessary norms of society. As a result, Black students are usually labeled by society as deviant and academically inferior.

Many of the students shared contempt for the countless messages they received suggesting that Blacks are underachievers. The students described comments, made by their Asian, Indian, and White mathematics teachers (K-16):

- [Gladis 's 6th grade science teacher response after Gladis announced her desire to become a mathematics professor] *Mathematicians are old White men. You would never fit in… and Gladis I mean that as a compliment.*
- [Chalmus's high school mathematics teacher's response as they pondered over potential career fields] *Yes, there is engineering, but you should pick a major that you are more likely able to graduate in.*

- ["Joke" from an AP high school mathematics teacher after Bobby announced to the class that he was attending Medium and majoring in Industrial Engineering] *Make sure you get a Chinese or Asian roommate!*
- A moment of disbelief from Wisdom's engineering teacher after she answered a challenging question correctly] *Really? Wow! I didn't think YOU would be able to answer a question like that! And no one helped you?* [Wisdom embarrassingly shook her head no] *Well, well, Bravo to you!*

As a result of teacher expectations, the students justified their preoccupation with proving these students wrong and sought the acceptance of a group of teachers who thought negatively of the students or the students' racial group.

Teachers and other authority figures were not the only ones to inflict racial trauma on the respondents. The informants heard racially charged comments from their peers as well. Below are a few examples of those comments (often disguised in a joking tone) verbalized by the students' White and Black peers:

- ["Joke" made by White TA at the end of a college-level mathematics class after Rich answered a question incorrectly] *The only reason why Afro-Americans know how to add and subtract is to count their welfare checks on the first of the month.*
- {Comment by an Indian male at a mathematics study group session, where Albert was a member] *Most Black people are afraid of mathematics so they just give up and do not even try. But Albert you're different because you are pure African.*
- {Comment made by a White female after approaching Olu at a party] *You are an engineer?! You don't look like an engineer. I figured you for a basketball player or psych {sic] major.*

- {Chris Black roommate made this statement after returning from a summer internship with a major telecommunication company] *You act too Black to land an engineering gig in corporate America. White people would be too afraid of you.*
- [Tiffany's response in her first interview when I questioned her about the lack of Blacks pursuing mathematics as a major] *I hate to say it, but most Black people just don't like math!*

These incidents provided students validation to focus on protecting themselves from racial stereotypes about Blacks in relation to mathematics and engineering. In response, the participants cultivated strategies to lessen the effects of racial abuse. Their main motivation to succeed in mathematics and engineering centered around "proving them all wrong" (Moore, et al., 2003) but they eventually came to realize that, no matter how much they achieve, racial stereotypes have durability and longevity. This fragile form of resilience was emotionally debilitating and wearying, as constant attention was required to counter the constant threat of stereotypes.

Conceptual models of Black identity are based largely on the premise that Blacks are a stigmatized and devalued group in American society (Chavous, Harris, Rivas, Helaire, & Green, 2004). I claim that this devalued social status is a major influence on Black students' achievement in mathematics and engineering. Although, some psychological research which asserts that racial stereotypes negatively impact academic achievement and lead to academic disengagement, the students in this study defended themselves against these stereotypes through high achievement, but not without heavy psychological cost. Similar to the effects of lower academic performance for these students, higher academic performance and persistence is, at least in part, a function of negative cultural views of Blacks. The respondents did not stop at rejecting racial

stereotypes and racial bias. With the knowledge of racial dynamics, the participants engaged in another important approach: they created, refined, and utilized what I refer to as *racialized survival strategies.*

The majority of participants cope with the racism of trying to succeed within a system that is designed to normalize failure for Black students. The participants used an assortment of racial strategies to lessen the threat of the stereotypes. Some students employed strategies that directly attacked the stereotype, while others adjust their behavior to the stereotypes (e.g., "acting White" or "acting Black") (Ogbu, 1991, 1994). Fordham & Ogbu (1986) made the argument, that because of their caste-like status, Blacks developed an "oppositional" culture that equated academic success with "acting White." Fordham (1988) found that Black students who are committed to school success devise unique strategies to cope with negative peer pressure. One of these is the "raceless persona"; some students minimize contact with other Blacks and for the most part adopt "White" values. It is important to note that most of the students who "act Black" or "act White" did it under the premise that they were performing these behaviors and not actually identifying with these behaviors.

Attempts to Counter Racial Stereotypes in General and Math in Particular

The students utilized numerous strategies to attempt to combat the damage that stereotypes inflicted on them. Living in a nation where extremely biased views of Black men persist, Black male students are especially challenged by societal stereotypes, and, according to Jimmy, negative stigmatization faced by Black males impedes their educational opportunities. Rob agreed, stating that Black males do not get the

educational assistance they need because "in most cases the teacher can't teach somebody she is afraid of."

Similarly, Mike felt the pressure and stress of always being "on point because I understand that some people think that Black people are stupid at math." As Mike discussed the disparities that existed inside his mathematics classroom, he complained that the White students often cheated and received no punishment whatsoever. Then he spoke of the day that he was accused of cheating. One day he re-entered his classroom after going to the bathroom and was accused of stealing a White female's cell phone. Mike noted the fact that he passed all of his mathematics exams with 85 percent or better and had turned in all his homework on time. Yet, he understood that his mathematics achievements did not excuse him from the damaging stereotype that *all Black men are thieves*. As a result his experiences, Mike contemplated dropping out of school and felt a sense of despair because of this and other race-based adversities.

Steele (1997) notes that Black students can feel that their intelligence and ability are always on trial even when they are effectively interacting and succeeding in school. Steele (1997, 1999) refers to this as *stereotype threat*, and it may foster the perception that one's academic achievements are undervalued in educational settings. According to Steele (1999), stereotype threat involves "the threat of being viewed through the lens of a negative stereotype or the fear of doing something that would inadvertently confirm that stereotype" (p. 46). In contexts in which particular stereotypes are active, individuals who are members of the negatively stereotyped groups will be conscious of the content of those stereotypes, and this may negatively affect their performance. Contrastingly, the participants' anxiety related to the presence of those stereotypes actually led to increased levels of successful performance. There is much less evidence

that stereotype threat can affect intellectual performance towards positive academic achievement (Moore, Ford, & Milner, 2005). The extra source of stress resulting from being negatively stereotyped actually was a source of academic motivation for the respondents (Steele, 2003).

In the fragile form of resilience, Tiffany developed hostility and the stress over racist incidents and her way of retaliation, mostly fighting, almost got her kicked out of college. Tiffany moved from her majority-Black community in a large metropolitan city, to a majority-White university in a rural majority-White surrounding community. Tiffany had to struggle against everyday racism, which Tiffany understood as, "What the hell are you doing here?" She described her experience when first entering an upper-level mathematics classroom as a dichotomy between invisibility and "hyper-visibility" displayed by at first shocked looks from her peers and then sudden quietness and withdrawal. There were also more overt forms of racism, like when a roommate of Tiffany's called her an "affirmative action student."

Eighteen of the respondents in this study endured the burden of being judged as affirmative action cases during their college careers. For example, Tiffany numerous occurrences of racism at her predominately White university left her feeling devalued and, for the first time, pondered over the thought that her admittance might have been based on affirmative action. This experience, along with a "bunch of [other] racist experiences" ultimately caused Tiffany to discontinue her education at her first university. The students stressed over and internalized the mainstream view of their success and identity. The devaluing of their academic abilities by others caused them to feel acute awareness of being Black and caused them to stay on guard, always prepared for the next racial assault.

Excels in Mathematics to be Perceived as Smart

Six of students (Albert, Damon, Jamaal, Mike, Rob, and Tiffany) in this study admitted to gravitating toward mathematics to be perceived as smart. The respondents recognized that excelling in mathematics meant being the beneficiary of privileged status and having access into the educational opportunities they needed to get ahead. As a result of receiving mathematics accolades and teacher recognition, the students were often chosen to be: speakers for school events; nominated for special academic projects; selected student ambassadors for partnerships with outside institutions, interviewed for the high school newspaper, and recipients of special recommendations from guidance counselors for college scholarships, etc. These students recognized from an early age that being perceived as smart in math was going to help them get the education that they deserved.

Preoccupation with Uncle Toms and Uncle Tomism

Some of the students came to the painful realization that some critical people in their lives (mathematics teachers, peers, and community members) believe that the underachievement of Black students like them is normal and to be expected. Many people who believe in this academic inferiority dogma are themselves Black. The students overwhelmingly referred to these Black people as "Uncle Toms." An Uncle Tom is a pejorative for a Black person who is perceived by others as behaving in a subservient manner to White American authority figures, or as seeking ingratiation with them by way of unnecessary accommodation (McWhorter, 2001; Steele, 2008). The students also reject "Uncle Tomism", a guiding principle or relationship between Whites and Blacks involving a benevolent but patronizing attitude on the part of the Whites and

a willingly submissive attitude on the part of the Blacks (Steele, 2008). Five of the students accept "Uncle Tomism" and embrace the negative stereotypes and inferiority of most Blacks (which have been refined by generations of White supremacy to include the Black elite- e.g., Shebly Steele, Condoleezza Rice, Henry Louis Gates, etc.) (Fish, 1993). Five of the participants' (Albert, Anita, Mike, Tiffany, and Wisdom), who were raised in predominately Black neighborhoods, did not encounter "Uncle Toms" until they arrived at college. It appears that growing up in a Black neighborhood may have shielded these students from overt experiences of racism. When they encountered "Uncle Toms" in college they lacked sophisticated strategies (such as racialized survival strategies) to deal with this new form of racial bias in their lives.

Clara spent most of her K-12 years attending predominately Black schools and lived in Black, economically deprived neighborhoods. Clara was teased by other Black students because of her dark skin and predominantly African features. These students ridiculed Clara for looking like the stereotypical and allegedly inferior image of Blackness, created by historical racism and White supremacy. To try and "escape" potential ridicule she assumed she would face at a historically Black university, she specifically decided to attend a non-Black university:

> I applied to an HBCU, I applied to Sturdus [a private white institution], and I applied to Medium University; and I got in all of them. HBCU offered me a full scholarship, but I didn't go because – the one thing that was in the back of my mind was if I went to an all-Black school I [was going to] get picked on a lot, and I didn't like it. And another thing about when I was growing up around Black kids, you know, they had, they had this thing about, "You dark, your nose is too big, you know, look at your hair; you don't have good hair." And I didn't wanna be around that in college. P: [00:41:14.12]

Clara let her fears of "Uncle Toms" keep her from attending a historically Black university, even with a full scholarship. Clara acknowledged that her contempt of

"Uncle Toms" caused her to temporarily disassociate herself from seeking friendships with Black students.

In her second year at university, Tiffany lived with a Black female student who did not associate with Black people and expressed very negative views about Black Americans. Her roommate spoke in a condescending tone about those she referred to as "ghetto Black people." According to Tiffany, her roommate only had White friends and expressed a longing to be White.

The students understood that racial discrimination against Black people existed but they did not realize, often until college, that Blacks could be prejudiced. This revelation caused self-doubt and hopelessness, anger and contempt, disbelief, and the most common reaction was to attempt to escape from the behavior. Clara avoided attending an HBCU because she was afraid of being ridiculed for her African features; Albert temporarily disassociated himself from college campus life; and "Uncle Toms" was one of Tiffany's reasons for dropping out of her first college.

Adheres to Some Aspects of Racialized Stereotypes

As a result of dealing with a multitude of stereotypes about Blacks and mathematics underachievement, many of the respondents purposefully adopted the everyday language (spoken and unspoken) of the dominant culture as an adaptive technique during their educational career. Even while some of the students criticized and loathed the obligation of "acting White," they felt it was a necessary practice toward being classified as academically astute. Because many of the respondents felt obligated to incorporate standards that just did not fit with their definitions of themselves, the

academic success they achieved was often bittersweet. The students expressed that their educational endeavors were somewhat undermined by mainstream cultural standards.

One of the main strategies used to assert parity was speaking Standard English. Speaking proper English for the students was associated with the perception of intellectual superiority. In academic settings, Hakeem exaggerated his speech pattern and spent time learning difficult vocabulary to demonstrate his mastery of "ultra-proper English" as an attempt to avoid stereotypical classifications at his majority-White elementary school. Hakeem concluded that he avoided getting teased and ridiculed in elementary school because he spoke better English and had a more refined vocabulary than most of his White peers. Several other students (Damon, Denise, Rich, Supo, Tiffany) said they were made to feel that their English was imperfect by White standards, which suggested distant or infrequent contact with Whites or lack of ability to master "proper English." It was not just oral communication that was problematic for this group of respondents; non-oral forms of communication were equally as damaging (e.g., Rich walks pass a car and hears the locks click; campus crime committed by a Black male and Supo gets questioned by the campus police at a school bowling party because he matched the description of the assailant).

Three students in the study (Bobby, Mike, and Rich) rejected the notion of "acting White" by deliberately acting out preconceived stereotypical notions of what it means to "be Black" and male (e.g., sagging baggy jeans, hat cocked backwards, white tee, Timberland boots, Afro or cornrow hair style, pimp walk, lazy eyes, slang talk, big gouty gold medallion around the neck, cigarette stuck behind the ear, etc.). For example, Mike purposely "acts Black" to disrupt "acting White" but yet he performs "acting Black" in a way that adheres to the negative demeaning stereotypical view of what it

means to be young, Black, and male. He intentionally follows a set of cultural laws that define Blackness in simplistic and one-dimensional ways:

> I never felt more Black than when I first got to college. In fact, I began to act more Black. When I was in high school I was strongly against what dominant society has taught us about African Americans, which is too urban. I always felt that I needed to show them the picture. I didn't want to look like them [stereotypically urban Black] cause, you know, everything attributed to African Americans was negative, and I wanted to show people it wasn't just that. But in my first year of college I changed. Grown-out Afro, baggier clothes; then everything I wouldn't wear in high school I began to wear in college. I was wearing Timberland boots, you know, really baggy jeans. Hat cocked to the side. All these things I would say were attributed to African Americans I would do in school cause I felt like I needed to. And if I didn't do, it I felt like I was separating myself out, like I wasn't being true. P: [00:24:14.26]

Mike realized that he showcased a Blackness that is not defined by his own criteria of what it means to be Black. Mike believed that his college community looked at him as an uneducated Black male, so he vowed to look like one by hyper-accentuating dominant perceptions of Black maleness. Mike confessed that his resistive stance continued to perpetuate the stereotype. As a senior in college at the time of the study, Mike celebrates his Blackness, by his own definition (i.e., baggy jeans with a belt, polo shirt, short fad hair cut, trimmed moustache, no hat, pimp walk but less exaggerated, and his Timberland boots).

None of the participants suggested that they wanted to divorce themselves from *being Black.* Even Cory, who showed the highest rate of assimilationist behavior according the MIBI and interview results, expressed value in *being Black* within the context of his Black identity. Although they perfected strategies for success, a majority of the students in this study stated that their preoccupation with racial stereotypes had created underdeveloped identities (in terms of being self-guided), by being consumed with proving their value to an educational system that devalued them daily.

Exhibits Talented Tenth Perspective

> ...The Talented Tenth rises and pulls all that are worth the saving up to their vantage ground. This is the history of human progress; and the two historic mistakes which have hindered that progress were the thinking first that no more could ever rise save the few already risen; or second, that it would better [for] the uprisen to pull the risen down. How then shall the leaders of a struggling people be trained and the hands of the risen few strengthened? There can be but one answer: The best and most capable of their youth must be schooled in the colleges and universities of the land...
>
> *- W.E.B. Dubois, 1903, p. 45*

Dubois (1903) envisioned a society in which the top 10 percent of Black Americans would acquire the necessary skills and education to succeed in the larger American society. This "talented tenth" would then eventually use their skills and talents to build a bridge between themselves and the remaining 90 percent. A few of the students are very critical of the Blacks that are not like them and they felt an obligation to try and help those Blacks, although the respondents were somewhat skeptical of the scope of their intended results. This is a fragile form of resilience because the students relied on negative conceptions of Black individuals, which are not like them, to make themselves appear more astute and worthy.

Dr. Bill Cosby challenged economically poor and "uneducated" Blacks by charging, "The lower economic people are not holding up their end in this deal. These people are not parenting." Several students (Gladis, Jamaal, Chrissy, and Olu) shared Cosby's sentiments and are sharply critical of African Americans who are economically "poor" and "uneducated." For example, Gladis blamed "poor Black people" for limiting themselves and not being open to "things outside of our neighborhoods." She stated that, "I think that there are a lot of intelligent Black people capable of doing a lot of

things, but we don't, we don't venture too far out of our comfort zones." Gladis had no qualms about blaming some Blacks for not moving outside of the "comfort zones" of their neighborhoods.

Chrissy stated the following about other middle class SES Black youth in her home neighborhood:

> I'm just sick of it and sick of them. Their parents have the means to give them whatever it is they need to be successful and they still decide to hang out on the street corners and do nothing. It's a shame that they just wasted their parents money like that. I have almost totally given up on them.

Chrissy felt that she was a bona fide member of the talented tenth club and gives the 90/10 distribution as another justification for the lack of Blacks in the field of mathematics and engineering.

These students used a myriad of strategies to lessen the effects of trying to academically succeed in an educational system they perceived them as inferior. Because of their early success in mathematics, a small number of students felt as though they were more gifted than most Black students, and idealized their achievements. This group of students blamed other Blacks for not doing what it takes to succeed and vowed to pull these "lowly" Blacks up, at least the ones that were worthy of saving.

It is important to note that other students in this study challenged this critique by suggesting the need for more options in Black neighborhoods for Black students to gain a variety of successful competencies. Damon spoke of traveling two hours, once a week to attend college preparatory classes in a suburb of his city. He was left wondering why he had go outside of his community and venture into spaces where their sense of self was threatened (i.e., he was often stopped by the police in while commuting to and from this predominately White suburb) in order to gain the necessary skills to succeed.

The coping strategies utilized by the respondents, for the majority of students in this study, did not ease the emotional distress of the never-ending demands of proving their engineering and mathematical academic worth. The participants' strategies had many different short-term results but their long-term effects were the same: they either experienced racial fatigue or created a bourgeois persona that retained false images of Black students and themselves. Mathematics achievement based on the perceived failure of their racial group confirmed the students' use of damaging external criteria by which they judged themselves and others. After retaining these reactive-based strategies for some time, the majority of the participants expressed tiredness that accompanied the constant grip of seeking out and destroying the cloak of low achievement. The temporary rewards of exercising these strategies (proving one or two White mathematics teachers wrong, winning a mathematics competition by beating the "smart" Asian kid, etc.) were typically short-lived.

Reactive Coping Strategy: Purses Academic and Math Success to Appease Parents

The majority of students had parents that mandated academic excellence in their households. Moreover, the respondents in this study cited the parental or guardian motivation as key supports in their development of mathematics literacy. This is a fragile form of resilience because the students cited parental pressure to pursue mathematics excellence for every reason but the development of the students' own passion to pursue the field. Some students felt pressured to engage in working toward mathematics-based careers, due to their demonstrated competencies in mathematics, early in their schooling. The parents' rationale for them to achieve mathematics and engineering excellence was linked to benefiting from larger opportunity structure. The

parents told their children that mathematics and engineering success would be the family's way out of the neighborhood. Some of the students felt extra pressure to succeed in mathematics so as to provide benefit for the whole family. The parents understood the history of Blacks in the U.S. and bestowed on their children a philosophy of education that had been passed down in the Black narrative tradition: *literacy for freedom and freedom for literacy* (Perry, 2003).

Rob's mother taught him this philosophy from a young age:

> My mother laid down the law, was very strict. My parents were divorced and my mom let me know from day one that we were poor and the only thing that we had going for us, I'm sorry, was our smarts and that we better get smart fast... My mom was all about education but don't mean that in the same way that other parents say they are about education but they don't spend any money on it....My mom said no to everything but books. So I was wearing raggedy-ass clothes but I had a lot of books. High achievement was expected. P: [00:28:22.21]

Rob's mother taught her sons that without education they would have nothing. Most of the parents fought hard to provide educational opportunities for their children. Most American parents were not able to provide direct assistance in mathematics for their children after about 7th grade (Jung-Sook & Bowen, 2006). But what many of the parents in this study did provide was their notions that learning and succeeding mathematics was of fundamental importance to the family's preservation. Most of the parents in this study provided their children with the understanding that without a mathematics or engineering degree they would not enjoy the same quality of life or be able to successfully compete with those who have one. Many of the respondents were left to feel that without a mathematics or engineering degree their parents would consider them failures and thus persisted in the field to appease their parents.

Outcomes for the Fragile Form of Resilience

Mathematics Identity

Mathematics education researchers maintain that many students evaluate their abilities in mathematics relative to external factors such as their peers and parents as well as siblings (Allexsaht-Snider, 2006; Martin, 2006a). The respondents had determined that positive performance in mathematics was expected by their parents and not expected by most others and that both forces led to their drive to exceed in mathematics in ways that produce undeniably high achievement. The participants' motivations for proving others wrong helped them in gaining mathematics success and recognition. Their motivations to make their parents happy helped to validate their reasons for pursuing mathematics. The results imply that the participants built their mathematics identities to receive externally based acceptance from perceived naysayers and parents. A concerted effort to produce high mathematics outcomes appeared to be necessary strategy to attempt to defy racial stereotypes and appease their parents. In the fragile form of resilience, the students' mathematics identities are developed under duress. Their mathematics abilities require constant attention and care because, unlike the rest of the non-Black "bright" mathematics students, notions of the informants' abilities do not transfer from mathematics class to mathematics class. As a result the students have to continually fight for the right to be treated as a high-achieving mathematics student.

Racial Identity

The students were often treated by their teachers, peers, and administrators as an opportunity to prove themselves as anti-racist. Some of the students in this study

accepted this form acknowledgement and actually began to associate themselves as special as and better than most, yet they all operated in ways that attempted to prove the negative racial stereotypes wrong. The respondents' racial identity within the fragile form of resilience internalized some of the society's negative view of Blacks. This identity operated mainly to disprove myths and satisfy others.

The students employed the racial stereotype of Blacks not achieving in mathematics by achieving in sometimes very stereotypically Black- or stereotypically White- played identities. Yet, these strategies while academically successful, lacked the sophistication needed to sustain critical self-consciousness. The students' reactive stances and positions were at variance with their self-definitions. The agency it took to prove their intellectual self worth often undermined their abilities to create a self-guided identity. When the students operated under the main premise of proving the deficit perspectives wrong, they suffered from being unable to indulge in a personal sense of self-defined success. The students began to question their strategies and motivations for achieving in mathematics and define and judge themselves and others by self-defined criteria; that is, a robust form of resilience.

Robust Form of Resilience

Twenty-two of the twenty-three students in this study demonstrated fragile forms of resilience that evolved over time to incorporate more robust forms of resilience. Learning from their experiences, the students decided that the continual challenge of battling stereotypes was not a good use of their time or energy. For example, Rich came to the conclusion that "being a mathematically astute Black male challenged their image of seeing me as an inferior student, incapable of learning mathematics. I had decided not

to let their fears affect me." Rich determined that the racial stereotypes persisted because of the fear by some of educated Black men.

The participants decided to explore the path of self-discovery. Disillusioned by the great efforts and minuscule rewards that come with fragile forms of resilience, the respondents summon a unique inner direction that is focused on maximizing success via their self-concept (See Figure 5.2).

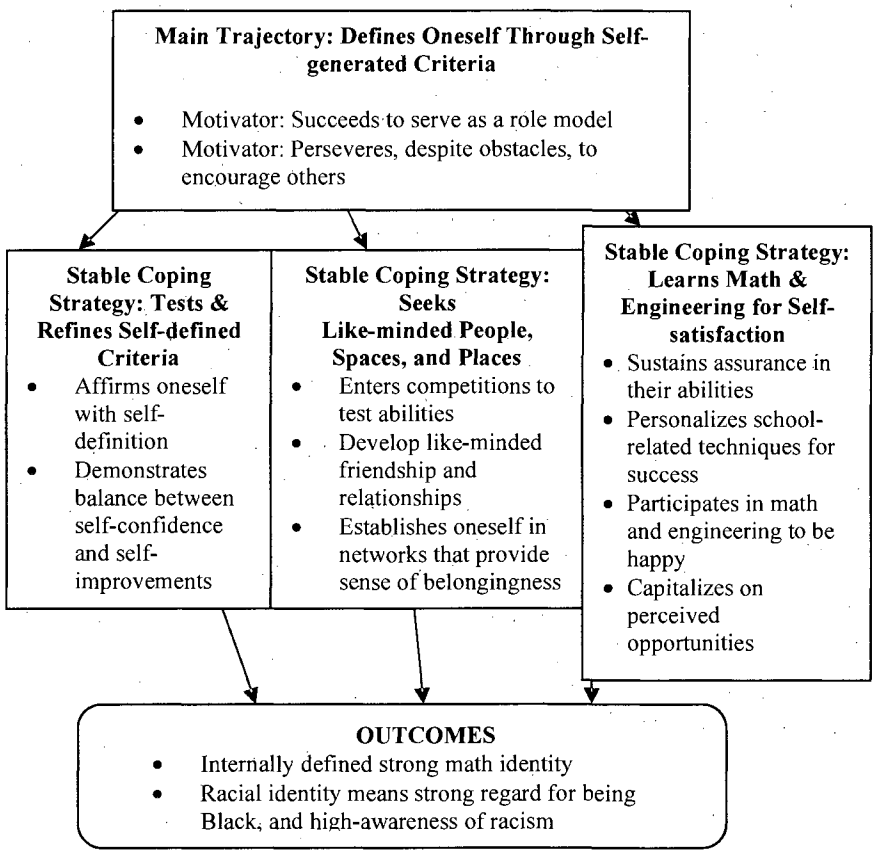


Figure 5.2
Robust Form of Resilience

The transition from the fragile form of resilience to the robust form of resilience was developmental. For each of the 22 students incorporated components found within the

robust from of resilience at all at different trajectories. In other words, only one student remained resilient by primarily operating within the fragile form of resilience. The 22 students employed three overarching strategies for maintaining their mathematics and engineering achievements. Stable coping strategies represent coping strategies that are not necessarily reactive but are manifested as internalized emergent identities. These strategies were employed consistently and incorporate the students' self-concept that they become coping tendencies that represented emergent identities.

Main Trajectory: Defining Oneself Through Self-Generated Criteria

Over time and with trail and error, the students realized that scholastic accomplishments should be motivated by their expectations of themselves and not by culturally dominant criteria. They understood that operating within imposed standards is at times necessary, yet they carried out those functions in concert with their own intrinsic desires. The participants revised their identities in ways that honored who they were, all the while functioning within the educational socio-cultural milieu. As college students, they were able to skillfully navigate success within the confines of societal bias without being guided by self-limiting or self-doubting criteria. Most of the students did not live by simplistic definitions of what it means to be or act "Black," instead they lived by what feels right to them. As a result of *being sick and tired of being sick and tired,* the students proactively sought out safe havens in which they could affirm their identities and abilities. This discussion of robust form of resilience covers the students' strategies and motivations above and beyond the fragile forms of resilience.

Motivator: Succeeds to Serve as a Role Model

The majority of the students' motivations shifted from proving the stereotype wrong to serving as a role model to Black mathematics learners to counteract potential racially biased learning experiences and outcomes. Not only did the participants have goals that included teaching mathematics, but they desired to teach in a way that values the students' culture. Imparting their own stories and keen strategies would allow aspiring Black engineering and mathematics students to be true be to their own selves and persist in spite of barriers that threaten to harm their achievements.

Eighteen of the participants envisioned their future as role models primarily by becoming mathematics or engineering instructors. Hakeem was so haunted by the desire to teach mathematics to Black youth, he decided to pursue a bachelor's in mathematics after receiving his bachelor's degree in accounting:

> I was getting ready to take the CPA [exam]. Repeatedly and it seemed like it almost every day I'm hearing these stories about the children and something in math. They need someone to teach the math, our kids are hurting. And this kind of touched my heart and I was like wow I know I'm an accounting major but I was just, gee, but if the kids aren't getting any help. I said I can reach out to those kids by teaching high school. And I can make them visualize and change their thoughts or ways and what they are doing because, I said to myself, because it's just the idea of how it's presented. That's where I am now, continuing my education. And in the next year or so I should be teaching. P:[00:38:54:10]

Hakeem spoke of a sense of responsibility to impart what he knows to the next generation of Black students. Valerie shared a similar goal as she aspires for her PhD in biochemical engineering:

> My ultimate career goal is to become a professor in engineering and like ideally I would like to go back to [an HCBU] and be that Black female engineering professor. [Instead of research] I'd rather be a role model. And show them like I said "you could achieve this. You could become a professor" I want to be a role

> model and help other younger people who are in engineering who need a face to put with that goal they are trying to achieve. That's my goal. P: [00:31:47.00]

Valerie was very explicit in where and who she wants to teach. Valerie realized the benefit of students seeing someone that looks like her, doing what it is that she wants to do. Valerie attended a historically Black university for her undergraduate degree in chemical engineering and had only one Black female engineering professor her entire college career. This professor served as Valerie's role model and she feels the commitment to give back.

Mathematics, and to a great extent engineering, have been positioned as a culture free or non-biased fields of study, yet these are often the most biased of classrooms (Evans-Hampton, Skinner, Henington, Sims & Mcdaniel, 2002; Martin, 2000; Secada, 1995). This was often evidenced in traditionally White male dominated curricula and lowered teacher expectations. Several of the students understood the need for teaching students in ways that acknowledge and value to their cultures.

Engineering careers can be very lucrative and two students (Clara and Wisdom) wanted to use their anticipated financial gain to build engineering institutions within their home communities. Also implicated in their motivations was the unique plight that Black men face in education and in their life chances to succeed. Clara, who has a son, understands the complexities of educating this population of students:

> What I really want to do is open a school for Black boys in the city. I know that with engineering I can kinda have a way to get money. But right now I'm interviewing with this school here called Urban Prep and it's a school for Black boys in Englewood. And they're housing it in the Englewood schools, my old school, so I'm applying there. I've always wanted to open a school for Black boys and here's this opportunity for me to teach at a school for Black boys. I'm like wow maybe this could be my chance to go after that but I want to go, for I definitely want to go for my PhD first. P: [01:16:22.19]

According to the American Council on Education, of the 1.8 million Black men of traditional college age -- 18 to 24 – only 25% were seeking higher education in 2004. Clara understood the bitter seeds of low expectations, apathy, and mediocrity that have been constructed in the lives of many Black male students. As Clara sadly acknowledged, Black males are far more likely than Black females to be celebrated for almost anything other than educational attainment. The role models typically held up for Black male youth, such as entertainers and athletes, rarely associate higher education as critical to success. For Clara the outcomes that currently exist for Black males require leadership, which she desires to provide.

These respondents sought to provide for Black students the type of knowledge that cannot be imparted by a White teacher. They realized their future and current roles as mathematics and engineering teachers would not just include the imparting of facts, algorithm and theorems but the development and advancement of Black students and their communities. These students yearned to help Black and other youth of color navigate the terrain of mathematics and engineering in ways that would create personal self-confidence and civic responsibility. These participants, as role models, want to demonstrate to students exceptional approaches for succeeding in mathematics and engineering academic life. The respondents accepted an additional sense of responsibility to work as hard as they can, so they can be in a better position to act as role models and mentors to Black youth and their own families.

Some participants did blame the school system for the underachievement of Black students in mathematics, but their accountability did not end at blaming the school system. A majority of the students in this study acquired a personal sense of

responsibility for becoming successful that extended beyond their love for mathematics and engineering.

Motivator: Perseveres, Despite Obstacles, to Encourage Others

As the students matured in age, their motivations for persevering in mathematics and engineering transformed from one of fear of failure to a more inspirational purpose. The students wanted to succeed in order to encourage and inspire their own families, youth, and students of color. The participants' obstacles, particularly the discriminatory experiences they endured as Black students in mathematics and engineering, served as a catalyst for encouraging others like them. Succeeding with a purpose to inspire is a driving force behind many of the respondents' future goals.

A number of students were also parents and persevered because of their children. Clara watched her mother endure physical abuse for most of her life. Although Clara promised herself never to repeat the cycle, at eighteen she found herself with two children, fathered by her physically and mentally abusive boyfriend:

> When I was younger and I would see what my mom was going through: I would always tell myself, "I ain't never gonna be with somebody that hit me." I would say growing up to myself, that's what I valued to myself. So he [the father of Clara's two kids] would hit me and my kids. I would be really angry and upset and trying to figure out what's going on. I knew for them I had to leave. I felt like I was gonna end up killing him. 'Cause I tried to run him over and thank God he can run fast. So I was like you know this is crazy. I knew I had to leave and because I think if I were to stay with him I don't think I would be able to graduate [from college]. P: [00:55:10.00]

Clara chose to leave her abusive relationship to provide a safer environment for her kids and educational space for her success. Clara thought that her boyfriend was jealous of her self-determination to complete her education and tried to make her feel guilty by making statements like, "you love those books more than you love me." By Clara's own

admission, she would not have been able to graduate college without leaving him. Clara, who was the former president of the National Society of Black Engineers for Medium University, was one of only two Black graduates in electrical engineering for the 2006-2007 semester at her school. Clara dedicated her degree to her two children and hopes that she has inspired them to achieve no matter the roadblocks that may come their way.

Some education scholars believe that teachers and the school system can be a negative influence on the mathematics education of not only Black students, but students in general (Ladson-Billing, 1998; Martin, 2000). Researchers have widely reported that some mathematics teachers intentionally steer Black students away from mathematics literacy and mathematics careers (Berry, 2005). Lisa, having first hand experience with the disparities in mathematics education, initially majored in education so she could become a better advocate for her son's education. But as he matriculated through the school system she discovered that through her mathematical excellence Lisa was able to provide her son with an environment where math is loved and not something to be feared:

> I was so determined for him [her son] to know that math is a beautiful, beautiful thing. But I didn't want him to get this sense of, I think there might be this fear, like, that's in not just Black people, Black children and—but in schools where they . . . it's like they're teaching children to be afraid of math and science. I don't know what's going on really. And they think, "Well, oh, that's okay." That, "When will you have to use this anyway?" Kids are left with the impression that they don't ever have to deal with this again throughout life. P: [00:46:02.03]

These respondents looked upon obstacles as a reminder of how much they had accomplished. Obstacles did not hinder the essence of these participants' motives—only encouraged them to succeed. These students did not speak of their success strictly in terms of personal mobility but expressed a collective sense of making it against the odds;

one that can be shared with other students who are striving to succeed in surmounting hurdles.

Stable Coping Strategy: Tests and refines self-defined criteria

The students decided to set criteria defined by their own standards and not by the deficit-based standards they used in the past. The students developed their own sets of rules, incorporated with the fragile form of resilience, to serve as a guide for maintaining academic and personal success. The participants enacted and revised their behaviors in ways that tested and affirmed the validity of their self-generated criteria.

Affirms Oneself With Self-Expression

For most respondents, self-definition is more complicated than merely identifying their individual characteristics and ideologies. These students operated between two types of self-definition constructs: the individual, defined through their own personal perspective; and the collective, based on interactions with their culture and society.

The bulk of students resisted formalized definitions of what it means to Black in America and rejected simple or one-dimensional characterizations of how to express Blackness. Damon talked about the shallowness of defining Blackness on so-called Afrocentric-only consumables:

> But you know, I mean, just because you got a dashiki on, right? And maybe you go get some jerk chicken down 79th, that doesn't mean anything, right, you know? You know what I'm saying? So, uh, yeah I would actually I think that that's different from embracing your Blackness. Just because you have the accoutrements and the sort of consumption items that identify you as Black, FUBU or dashiki, whatever, that doesn't mean that you've dealt with the sort of negative training that comes from living in this culture that devalues you, and particularly devalues your intellect, and in particular devalues your mathematical intellect. 2 P:[00:04:11.24]

Damon affirmed that his definition of Blackness includes understanding racism and understanding your "true value" as a Black individual. For Damon, eating jerk chicken and buying FUBU (Black clothing manufacturer) clothes is meaningless without knowledge of self, and uncovering the constructed nature of how race negatively operates in the lives of Black people.

Humor and jokes allow people the pleasure of laughter; and many Blacks utilize humor as a method of dealing with racism (Pincheon, 2000). The expression of comedy for some Blacks has become a therapeutic tool for creatively, compassionately, and honestly dealing with race and racism. Rob employed a variety of techniques to "cheat" the effects of racism. One strategy was his use of satirical, witty, and insightful humor to expose racism in a way that produced thought as well as laughter. Rob had me rolling in laughter all through the interview. When I asked him why he felt there were so few Black students succeeding in mathematics, he responded with a revealing comical narrative:

> I was watching NBC news 'cause I like to see what the corporate media wants me to think, okay, just to remind myself that I'm being brainwashed, and, sure enough, every now and then, especially in February, they have a feel-good story about Black people. This young Black man was teaching local drumming to the kids. Maybe he'd been in trouble, been in gangs, maybe this is what got him out of trouble, so now he was spreading the word and it's having a positive impact. You'll see a lot of stories like this, okay? Invariably, especially when it comes to Black people, the person is essentially either encouraging the student to do music, dance, or sports, so on. [Now] look at what the acceptable range of activities [are]. And you know that's where my old-school, angry-old-Black-man mentality comes in, which is, "Okay, that's great. Beatin' on drums. Thank you for encouraging us [Blacks] once again to beat on some fuckin' drums, okay?" 2P:[00:26:28.15]

Granted, one may be offended by his harsh look at reality and his uncompromising use of language, but as Rob further interpreted his rationale for being so funny, he

clearly rejects the notion that Black students should aspire to simplistic forms of success, and demanded that educators insist on educational equity for Black students (Chesler, Lewis, & Crowfoot, 2005). Rob used humor to reject racism and still preserved his wittiness in a manner that keeps him from "going crazy." For Rob, his use of comedy did more than relieve the boredom that a trite, statistical representation of racism might engender; it is actually a form of resistance against racism, driven by highlighting the racial trauma of Blacks in a way that communicates a higher truth. Rob affirmed that comedy is his vehicle to confront racism in way that heightens his sense of survival and preserves his sanity.

Demonstrates Balance Between Self-Confidence and Self-Improvement

The majority of respondents evaluated themselves in realistic, yet self-affirming ways that further promoted their mathematics and engineering academic achievement. Ten of the students noted their self-confidence developed as a result of constantly defending their intellectual capital. The relationship between confidence and achievement was central to their mathematics and engineering identities.

Higher self-concepts for Black students, coupled with lower academic achievement, have led researchers to conclude that self-concept does not play a prominent role in academic achievement (van Laar, 2000). Yet the relationships between the self-concept of Black students with high academic achievement are under-explored (Cokely, 2000). In this study, the students' positive self-concept aided their academic achievements. The students representing this section thrived from their academic achievement. Clara noted the differences in her self-confidence and her Black peers:

> ...I noticed something different about me than a lot of other African American students is I have always had confidence in myself. I never ever approached something with a presumption that I couldn't do it, never... maybe it was arrogant but I always felt like if I want to do something I could do it and I still feel like that. I feel like if I mess up then that was experimental, that wasn't me. I feel like if I tried to do something, I could do it, period. And a lot of students, a lot of my classmates in high school were very not confident when it came to math, like they didn't want to try it. [01:02:20.00]

Clara's "unstoppable" disposition allowed her to benefit academically, even in times of academic and life turmoil. One speculative conclusion is that Clara's self-determined attitude is related to her high academic self-concept (Cokley, 2000) and success in engineering.

Included within these respondents' notion of high self-confidence and self-concept was a realistic sense of self, as they readily self-identified areas of needed improvement. Rob, although he ultimately indicted racial stereotypes for his rationale to discontinue his education at Science Tech, also illuminated his own personal flaw: his lack of drive to excel in non-mathematics classes.

Although some may view the respondents unyielding sense of confidence as conceit, but Supo explained that in a field where "nobody believes in your abilities you better be armed with some extra confidence because you are going to need it for all the haters." These students self-praised as well as engaged in constructive self-criticism, but utilized self-critiques mainly in concert with self-improvement.

Stable Coping Strategy: Seeks Like-Minded People, Spaces, and Places

The students in this section set their own standards for how they defined themselves and the people and places they surrounded themselves with. This is a robust from of resilience because the respondents frequently chose people, spaces, and places that they

felt the most comfortable around and who had similar goals for success. As opposed to being surrounded by people that do not believe in your abilities, they acquired friendships and spaces that enhanced their self worth. Encircling themselves with other self-defined individuals and groups was an important part of maintaining academic success and personal fulfillment. Most respondents sought out individuals, networks, and ideologies that provided increased opportunities to pursue their mathematics and engineering goals. The majority of the respondents found or created spaces where their talents could be embraced, mentored, and acknowledged in ways that promoted and highlighted their racial identities.

Enters Competitions to Test Abilities

One method that some of respondents used to surround themselves with like-minded people, with similar skill sets was through sports and mathematics competitions. This is a robust form of resilience because they discovered places where they did not feel like outcasts and could just be themselves.

Just as stereotypes exist about Blacks in mathematics, there are also racial ideologies about certain sports activities that are considered non-traditional in the Black community. Several participants (Cory, Lisa, Jimmy, and Valerie) engaged competitively in a number of sports considered atypical for Blacks; such as swimming, tennis, and soccer. They utilized their academic competencies in mathematics as well as their abilities in sports to navigate educational opportunities and to be around people that shared their interests and passions.

Considering the racial dimension of sports, there are subtle unwritten rules about what Whites are supposed to be good at and other in which it is believed that Blacks

excel. And many justify Blacks' right to dominate in certain sports because they lack opportunities elsewhere. Cory, Lisa, Jimmy, and Valerie problematize the notion of Black physical superiority by implying that physical talent does not correlate with intellectual inferiority. These students found sports that they liked and engaged in them with the same vigor the used to navigate mathematics and engineering success.

Many of the respondents, particularly the males, took pleasure in winning and learning from their losses in mathematics competitions. Chalmus believes that he developed a sense of fearlessness through his failures and successes in mathematics competitions. He also developed some lifelong friendships with a few of his fellow mathematics competitors. Learning to beat his friends and foes served as a valid way of maintaining belief in his mathematics abilities:

> [Mathematics competitions made me] pretty fearless. I did a lot of math contests and math contests are different than regular math because the people that write these contests, they purposely try to find the most obscure concepts that they can to test your ability and I was really good at it and I won a lot of awards for [City] public schools and stuff like that. P:[00:07:32.19]

Participating in mathematics competitions, win or lose, helped these students to exercise their competitive spirits and enjoy a commonality with others who shared their same zest for mathematics and sports.

Develops Like-Minded Friendships and Relationships

The respondents in this section purposefully developed relationships with like-minded individuals to help them stay focused on their goals. These relationships also served as a protective barrier against individuals who did not understand them and their mission of achieving in mathematics and engineering. These students learned that

their choice of peer networks can positively or negatively influence their academic achievement.

Tiffany's mathematics identity was well established since childhood, but her academic identity outside of mathematics did not dramatically improve until her junior year of high school. Tiffany expressed that her newfound desire to achieve in courses outside of mathematics was influenced by her new group of friends who possessed achievement ideology behavior:

> My first year at Krobet Park high school, I didn't do so well. I wasn't exactly the best student so my GPA was maybe like a 2.5. The person who was my best friend when I first got to high school, we was real cool and tight. But then she started hanging out with people who was smoking weed and doing stuff. I was just like forget this, I'm gonna hang out with these other people. And at first when I first started hanging out with smart people, it was kind of nerdy but then I started to like them. That's when I first started taking like the advanced courses like my junior and senior year, that's when I started making the friends I needed to and that's when my GPA started getting better, better and better. P: [00:13:53.07]

In her last two years in highs school, Tiffany enjoyed success not only in mathematics but in most of her school subjects. With new friends Tiffany felt an appreciation in "getting straight As" and pursuing college education. Tiffany decided to attend a large out-of-state college due to the exposure her friends provided on out-of-state colleges. As a result of these friendships Tiffany began to think more dynamically and critically about her educational future.

Establishes Oneself in Networks That Provide a Sense of Belongingness

Of the 23 students, only 5 were exposed to their subject through an engineering or mathematics mentor prior to college. For most of the other respondents, the primary source of mentoring was through the organizational mentorship of *The National Society of*

Black Engineers (NSBE). NSBE is a student-based organization with the purpose of increasing the number of Black engineers, who excel academically, succeed professionally, and positively impact the community. These respondents benefited from the NBSE-sponsored networking and fellowship opportunities and viewed the organization as a safe space to flex their mathematics and engineering identities.

Two of the six graduate students in this study, two, Jimmy and Valerie, chose HBCUs for their undergraduate colleges because of their combination of high-academic rigor within a pro-Black setting. Valerie, who grew up in a majority White neighborhood, experienced a new and welcoming sense of belongingness in her college experience:

> I would say just being able to be around so many Black people who are like moving forward, who are in class, who are doing the work, it was very empowering. I feel like just knowing that there are other people like me who are able to succeed and I think that's something that I definitely did not get in K-8 or high school. But just having so many people around and being able to identify with other people and just know that it's not just me and five of my friends, Black friends who are doing well and it was emotionally uplifting. P: [00:15:21.14]

Being raised in a predominately White environment, Valerie was exposed to the same negative racial stereotypes that most youth are exposed to. Valerie sought out positive counter images and stories to debunk racial myths. Reflecting on her neighborhood experiences, Valerie felt like an anomaly, "not really Black" because her family was "quiet and respectable" and because Valerie and her brother were "smart." Without exposure to counter those racial stereotypes, Valerie, on some level, felt as though she was different from most Black people and admitted to pathologizing her race to a certain extent. Attending a historically Black university and interacting with hundreds of academic high-achievers helped her diffuse her own racial misconceptions. Now that Valerie is attending Ivy University, she serves in a leadership position to stand

up and speak out in the face of racist incidents, which unfortunately continue to thrive on Ivy's campus.

Lisa identified with other "outsiders," individuals who were considered social outcasts in high school, even at the expense of being ridiculed. In high school, Lisa's group of friends where of all different races and she was often accused by her Black peers as being a traitor to her race. Yet, those same Black peers, who were mostly female, often left Lisa feeling uncomfortable by their frequent backhanded criticisms. As a result, Lisa distanced herself from forming friendships with Black females. Lisa attendance at a predominately Black university allowed her the space to heal those old racial wounds and begin nurturing friendships with Black female and male students who shared her passion for learning and success.

These students intentionally sought out places, people, and places that validated their sense of identity and purpose. For some of the students that meant surrounding themselves with other Black students with common interests, while others chose different criteria such as hanging out with the "outcasts" or people within their major. What the respondents shared is the ability to self-define and proactively seek out individuals and networks that best supported their academic and personal success.

Stable Coping Strategy: Learns Mathematics and Engineering for Self-satisfaction

The students in this section find solving tough and complex math and engineering problems fun and challenging, and some displayed their talents in these fields like a badge of honor. Seventeen of the students in this study rejected or discarded the notion that mathematics is outside that cultural norm of what is cool or what Blacks were capable of doing. Not only did these respondents demonstrate an aptitude for learning,

they also possessed the motivation to withstand the challenges and difficulties associated with mathematics and engineering.

Sustains Assurance in Their Mathematics and Engineering Abilities

The participants attributed their success in mathematics to their superior mathematical abilities, and if they scored poorly on a mathematics or engineering test they tended to cite a lack of preparation – anything but lack of ability. Attributing mathematics and engineering success to their abilities made it easier for them to bounce back from failure or disappointment, and gave the participants a lot of confidence in the face of tough new challenges. As Jimmy's exclaimed, "I am good in mathematics, so there was nothing stopping me from being good in algebra, advanced calculus, and quantum physics!"

The belief in their abilities allowed the students persist under pressure. The difficulty of number theory does not deter Cory from pursuing his mathematics degree:

> Number theory is my favorite topic of math and there's a lot of stuff I don't understand in it. It's probably one of the hardest classes I've ever been in. I took it once in high school and now I'm taking it again and it should be easy for me but no, it's still difficult and I don't always get the concepts. When I don't get something in number theory it doesn't even bother me. I just keep working at it, I just keep trying. P:[00:06:14.28]

The students shared a high degree of aspiration and were able to envision success in the face of mathematics and engineering confrontations. Sustained motivation for achievement is present throughout the informants' mathematics and engineering academic trajectories. Any perceived incidences of academic failure are viewed as temporary and they continued to persist in mathematics and engineering.

Personalizes School-related Techniques for Success

The students created, in part with their understanding of how success works in mathematics and engineering each created an individually custom-made study guide that they used to navigate the success within these fields. This is a robust form of resilience because it utilizes the students' know-how and learned experiences in the field to carve out a plan of action that works best for them.

The respondents' test taking and study strategies were very atypical in design and did not mirror the traditional representatives of good study habits (i.e., organized and tedious note taking skills, 8-9 hours of sleep every night, etc.). The students had developed more personalized strategies that incorporated their personalities and character traits. For example, when Hakeem studies for mathematics tests, his strategy is to cram the night before until 2 a.m. in the morning, then plays video games until he eventually goes to sleep; for an 8 a.m. exam. For Hakeem, this is a highly successful strategy because he consistently scores 90% and above on his mathematics exams.

The over 60% attrition rate of all but dissertation (ABD) mathematics and engineering candidates speaks to the perils of getting a PhD for all students, and these numbers are even higher for Black doctoral candidates in mathematics and engineering fields (White, 2007). So for Valerie, a PhD student in biochemical engineering, she realizes that succeeding in a PhD program at Ivy University requires her mastery of engineering but also understands the politics of getting a PhD:

> Doing well in academia in my opinion is very much a politics game. Having my advisors push me and promote me outside of the Ivy community is a plus. But then once I'm here am I able to perform at that level? I'm trying to get advice from other graduate students who are working on their application package in order to become a faculty member. I'm also reaching out to young faculty members. There are two faculty members in particular that I'm reaching out to in

> order [see]... how I can tailor my job search and my faculty application package to go into the schools that I want to. P:[00:18:14.20]

For Valerie, navigating the politics outside of the classroom is just as important as the research her performs. Although Valerie estimates that she is about 4 to 5 years away from receiving a PhD, she is already investigating the faculty process.

Another approach three students instigated (Denise, Feya, and Mike) is navigating within their comfort zones to gain the information needed to succeed academically. Denise is afraid of asking questions in engineering class for fear of "looking stupid." This is typically not a characteristic expected of a high-achieving college engineering student. However, she did not let that impede her from getting the information she needed to comprehend the material. Denise went to the teacher's assistant or the professor during their office hours to gain the proficiency she required to remain successful in her classes. Denise stated there is a delicate balance between "asking the right question and getting on your TA's [Teachers' Assistant] nerves," but if performed correctly, she contends it serves as a powerful strategy for gaining competencies in her engineering classes.

These respondents developed their own strategies, which at first glance may appear to be quite unorthodox. Yet, these personalized strategies are based on what works best for them within the system of mathematics and engineering success.

Participates in Mathematics and Engineering to be Happy

The students incorporated their mathematics and engineering learning as a part of their human search for understanding the world and themselves. They applied concepts learned in mathematics and engineering to many other aspects of their lives. For these

students, learning to think in analytical terms is an essential part of their thinking about the world and their purpose in it. Their success in mathematics and engineering serves as a personal stance to thrive and flourish in a discipline that they love.

Many college students chose their career goals based on the potential financial opportunities their fields of study afforded them. Yet for most the participants in this study, personal happiness came first and money was a second, sometimes even third of their lists. The mathematics students in particular acknowledged the undesirable pay in their desired mathematics-based careers, the long hours, and the amount of mathematics knowledge required to be considered "an expert" in the field. Yet, their unconditional love of mathematics was more of a motivator than materialistic aspirations. For instance, Cory switched his major from engineering to mathematics but not without consideration of the "$20,000 a year in salary I may lose along with a guaranteed job." However he made the switch from engineering to mathematics for more intrinsic reasons:

> Honestly I feel it's because [mathematics] is not really a career choice that makes a lot of money. But then when I made the switch to math it actually took me awhile because I had to keep thinking to myself "what am I going to do when I graduate?" I mean doing math, your fields are pretty limited. You can do education or you can work with the government or you can become an actuary. But I love math so much I didn't even care. Actually I asked an actual math teacher before I made the switch what he thought about doing an applied math major and his response to me was "I hope you like math," "yeah, I do," and he said, "no, I hope you like math a lot." I understood what he meant. I had to make that decision that I may not know where I'm gonna end up when I'm done with this but this is what I love to do. P:[00:23:21.11]

The respondents not only performed in their fields to achieve academic success, they did mathematics, engineering, and science problems in their spare time, often for the fun of it. They truly enjoyed their majors and could not imagine doing something else. Lisa called it a healthy obsession. When Lisa compared herself to her classmates, particularly in high school, she often felt out of place. When her classmates were pre-occupied with

romantic relationships, money woes, name brand clothes, the latest rapper's business, and were more than satisfied with "never doing another mathematics problem again," Lisa was invested in blending mathematics and physics together into one discipline. Her passion and love of both mathematics and science helped her to balance the other non-school issues in her life and gives her a sense of purpose.

These students have deliberately chosen to follow their passion over all the temptations that often exist for academically successful students. Although many of the participants have contemplated the possibilities of following another career path, they ultimately decided that what is best for them, financially, emotionally, academically, and career-wise is do what they love.

Capitalizes on Math and Engineering Opportunities (That They Perceived as Beneficial)

These students proactively sought out and took advantage of opportunities that could propel their overall mathematics and engineering success. This is a robust form of resilience because they made good use of programs that exposed them to the employment and research side of mathematics and engineering. The students were able to validate their desires for pursuing mathematics and engineering with the incorporation of real world experiences. It is important to note that the students did not accept every opportunity that came to them to engage in mathematics and engineering, but only the ones that they perceived as beneficial. For example, Anita as a high school student enrolled in a summer program for high-achieving student of color on a large prestigious college campus. Although, the program was offered as a student of color initiative Lisa, was only one of 3 Blacks in a cohort of 75. She felt uncomfortable in that environment and after two weeks she dropped out. Learning college level mathematics

was not beneficial because she perceived the environment as unwelcoming and harmful to her racial identity.

Participants sought out and created opportunities to acquire knowledge, recognition, and new skills. This gave the students a greater sense of empowerment and impelled them to take advantage of particular opportunities to enhance their learning process and to critically evaluate their life experiences. Many of the students sought out job internships, high school summer camps, and workshops, and enrolled in mathematics and engineering classes outside of the standard curriculum.

Jimmy competed for a coveted research assistantship with a professor doing work in his area. Although his research assistantship came with long hours and a demanding boss, Jimmy knew this was the opportunity he needed:

> I also got into doing research within mechanical engineering and probably that was my second year. I started working on a grant project with Dr Crieger and I think that you know now, in addition to classes, kind of put the stuff to real life work. So that definitely gave me an added boost of confidence. P: [00:31:29.16]

Working with Dr. Crieger allowed Jimmy to test a working model that he eventually used for his senior undergraduate project in mechanical engineering. Jimmy considered himself pretty self-motivated. He performed his own tests in the lab without the hassle of negotiating lab time and had unlimited access to the materials needed to conduct his studies. Jimmy realizes that his participation as a research assistant laid a more complete foundation for his research.

Another method the students used to test their academic skills was through summer programs, often with other mathematics and engineering students of color. Many of the summer programs the students attended were intended to promote student success and to increase college graduation rates for "academically and economically disadvantaged

and underrepresented students." Although these programs promote certain generic competencies (i.e., improved study and note taking skills, development of group interaction skills, improved time management abilities, etc.), Valerie jumped at the opportunity to be a part of a summer programs at an historically Black university:

> I did go to a program. It's called the SOAR program at Wayer University in Louisiana. It was over the summer. It[s a four-week class that is just focused on math and physics. It was geared towards minorities so it was almost all Blacks and Hispanic people there. And that made me more interested to go to college and pursue engineering cuz it was the summer before my senior year of high school. P: [00:09:57.15]

What Valerie said she most benefited from was being able to test her abilities with those of her peers. Valerie stated that she knew her school was "the best of the worst" and to test her abilities with students from "smarter" schools really helped to validate her mathematics and science intellect.

Outcomes for the Robust Form of Resilience

Mathematics Identity

As the students developed a robust form of resilience, their mathematics identities incorporated more internalized psychological beliefs about their ability to successfully achieve within mathematical contexts (Martin, 2006a). A majority of the participants expressed the importance of mathematics and engineering in their lives (Martin, 2006a). The respondents had a hard time imagining their lives without their mathematics achievement, although many positioned mathematics in combination with other disciplines (e.g., engineering, physics, business, and entrepreneurship). The students had strong opinions about their abilities in mathematics, which have been tested and refined throughout their academic careers. The informants have reassessed their reasons

for participating in mathematics and engineering, which overwhelmingly reflect the ability to change the conditions of their lives through impacting the mathematical lives of other Black students. This did much to lessen their previous motivation of proving stereotypes wrong, although these motivations were not completely buried. This demonstrates the evolving nature of mathematics identity; as resilience reallocates from fragile to robust, the participants' mathematics identity becomes and remains robust (i.e., internally motivated and intrinsically developed).

Racial Identity

The students learned to accept themselves and possessed a healthy sense of racial identity. The majority of the students had a dynamic understanding of race and racism and how their worlds were influenced by it. The majority of the students were able to function in the White mainstream environments of many mathematics or engineering colleges while maintaining identification with Black culture. For some, their mathematics and engineering achievement and their self-guided identities confirmed their equalness as human beings and they achieved psychological integrity as well. The students at predominately Black universities found comfort in Black friendships and other Black networks that enhanced their Black identities. Even those few students who did not foster associations with the Black community were still content with being Black. The students transcended racial stereotypes and functioned beyond superficial levels of racialization. The majority of the students preserved a racial identity that incorporated a sense of dignity for being Black.

CHAPTER 6

THREE LIFESTORIES OF MATHEMATICS AND ENGINEERING ACHIEVEMENT

> The world of math: it is competitive; it is brutal. There is a racial hierarchy in this country [which] exists, a caste system, and when it comes to [the] smarts department—especially in mathematics—we [African Americans] are on the bottom. That's it. I mean, that's it. Fortunately, I have a good sense of humor; otherwise, I think I'd go crazy.
>
> *– Rob, 40-year-old, high-achieving Black mathematics doctoral candidate*

> I never had a Black engineering professor, so I don't know what people are saying about Black professors because I have never had one. Not a [Black] math professor either. Actually I only had one Black professor in my entire college career, and he taught African American studies.
>
> *– Wisdom, 27-year-old, high-achieving Black bio-engineering masters student*

> I have an obligation to work as hard as I can and take things as far as I can just because there aren't that many of us [African Americans]. It's not that I believe I'm better than anybody else; it's just that there aren't that many math professionals to begin with and there are even fewer African Americans, so I figure if that's what I'm into, if those were the gifts that I was given, I should go ahead to pursue that.
>
> *– Cory, 20-year-old, high-achieving Black mathematics senior student*

In this chapter, I provide three in-depth case studies of the robust form of resilience. The incorporation of the robust form resilience with the fragile form of resilience happened differently for each of these students. I chose these three students in particular because of how differently they viewed the significance or operation of race in constraining their academic and life chances. Although all three students self-identified as African American or Black, they differed in their association of the collective struggle of Blacks with their success and in whether or not they attributed their success to their

own personal agency and intrinsic drive. To round out my understanding of these three students, I utilized the life story approach, which provided in-depth characterizations of several stages of the students' lives to complement the counter-narrative methodology presented in the case studies.

The stories of Rob, Wisdom, and Cory reveal the ongoing sacrifices and the public and private forms of resistance, resilience, accommodation, and struggle that these Black students negotiated to achieve mathematics and engineering achievement (Anderson, 1988). These narratives demonstrate how students like Wisdom, who acted as a "double agent" to succeed in mathematics, empowered younger Black and Latino students to develop mathematics literacy. These students reminded me as a researcher that their lives and the world we live in are not one-dimensional. There is no one meta-story that defines Black students in mathematics and engineering, and looking at a multitude of individual and social factors is crucial to honoring their narratives (Tate, 1994). Taken as a whole, these stories contribute to the growing body of literature that portrays achievement from the perspectives of Black students.

As a subgroup, their social background characteristics varied widely, reflecting the diversity of the research sample as a whole. Consequently, these three students provided a unique opportunity to explore the factors that spur Black students on to mathematics perseverance and buffer them against academic underachievement and the factors that lead other similar students to lose hope and give up. Rob and Wisdom provided a powerful critique of their mathematical learning experiences within the context of being Black (Martin, in press). Rob, Wisdom, and Cory all exhibited multiple strategies for resisting and ignoring racism and racial stereotypes. These three students' career and personal interests went hand in hand with a desire to improve mathematics

and engineering education for Black students and youth of color through teaching, mentoring, and tutoring.

Identification of Risk and Protective Factors

As was stated in Chapter 5, the fragile and robust trajectories are developmental and occur through the course of the participants K-12 experiences. This also holds true for identifying the students' risk and protective factors. They too, change and develop over the course of the students' academic career. In the PVEST, risk factors and protective factors were, in part, identified by the students themselves, based on their individual perceptions and meaning making (Spencer, 2006). Therefore these participants were asked to identify their risk and protective factors.

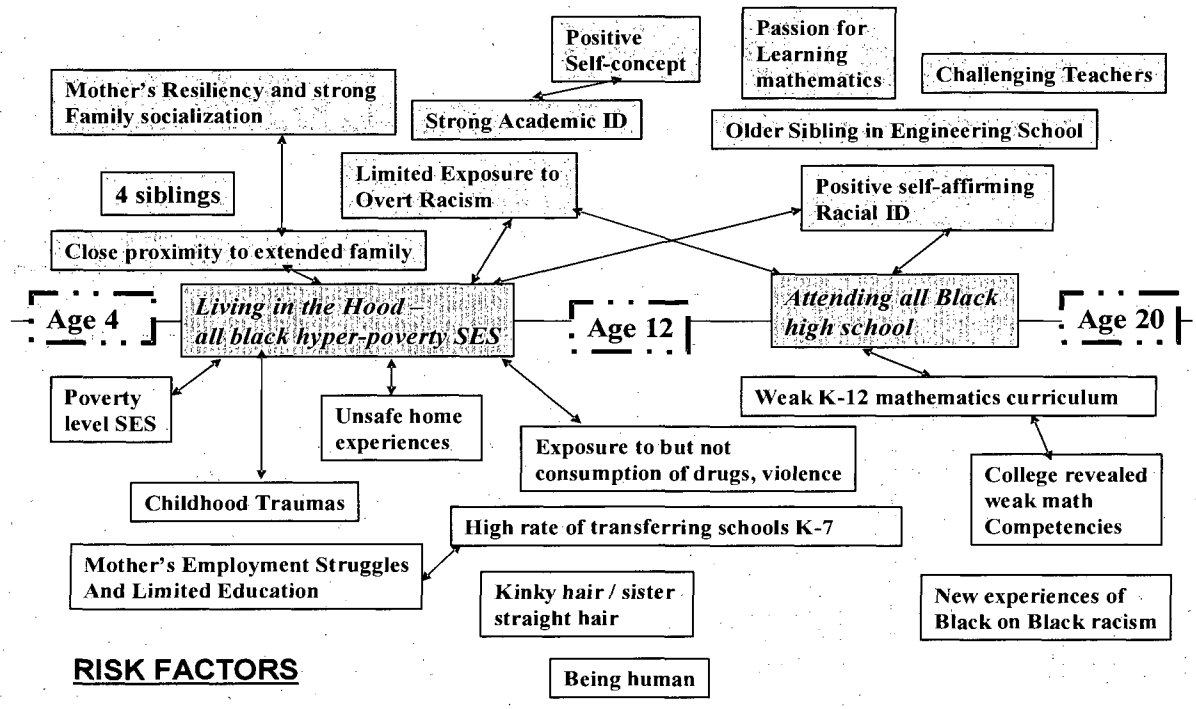
As Spencer (2006) appropriately noted, all human beings are vulnerable and carry varying degrees of risk and protective factors. Previous research has painted an erroneous picture of Blacks acquiring a high number of risks conditions, while protective factors are ignored or underemphasized. Generally, most of the students in this study identified a high number of risk processes that factored in their lives. These processes varied widely, dependent on how each participant perceived and defined risk. I will present the risk and protective factors of these three students to examine the variability in how these factors are mitigated and, in some cases, diminished.

Rob and Wisdom listed a host of risk factors, Cory did not. Adapting Spencer's model above, and incorporating the notion that risk and protective factors change over a person's life course, I mapped out the life story chronologies of the protective and risks factors of each of the three case study participants. I conclude that Wisdom and Rob's vulnerability level predictions lie in the quadrant where resilience is expected.

Contrastingly, Cory's life trajectory appears to one of "masked" vulnerability in his college years. Later, I will offer further comment on Cory's risk vs. protective results, due to his inability to "see color" which may have distorted his ability to identify both his risk and protective factors.

Wisdom's Net Vulnerability

All three participants share the risk factor that comes which being human. All humans have risk. For Wisdom the most salient early risk factors dealt directly with her hyper-poverty "all Black" neighborhood. When Wisdom described her risks, not once did she ascribe the racial make-up of her neighborhood a role in her anticipated risk. She did describe the result of living in a high-poverty neighborhood: drugs, violence, robberies, watching her mother deteriorate physically and mentally due to hard and long labor, and other ills. Yet, Wisdom's story of living in a hyper-poverty "all Black" neighborhood had a protective side. Wisdom spoke of a strong family bond, due in part to the close proximity of the maternal part of her family, who also lived in the "ghetto." She also spoke of her mother's strength to keep pushing for something better for her family, no matter the struggle. Wisdom exclaimed that she did not experience racism until college. Although, she failed to connect the notion that her family's high-poverty and all Black neighborhood could be attributed to structural racism in its worst form, Wisdom seemed to benefit from not having had any overt racist experiences (besides her classmates wondering why her hair was "so nappy" while her sister had "good hair"). Wisdom attended an "all Black" high school, where she felt challenged and appreciated as she excelled academically. Her teachers encouraged her to pursue mathematics and, coupled with her brother's experience as a engineering student, Wisdom felt capable

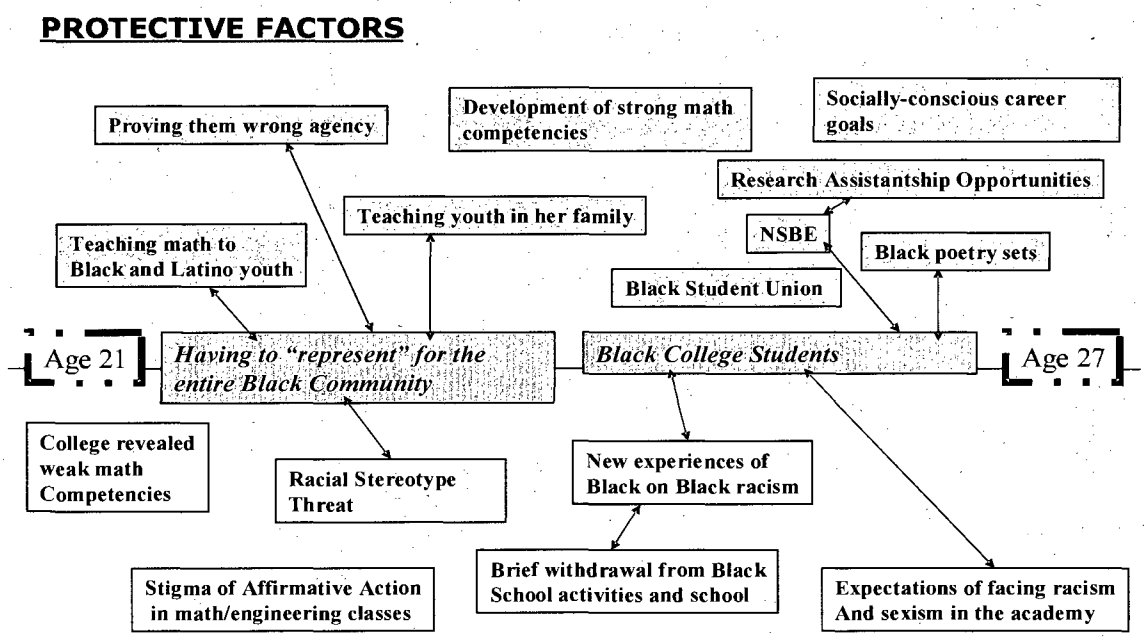


Solid Gray Boxes above Time Line: Protective Factors **White Boxes Below Time Line:** Risk Factors
Patterned Boxes Situated on Time Line: Serve as Both Risk and Protective Factors **Arrows:** Participant Described Direct Correlation Between Factors/Processes
High Risk Factors + High Protective Factors = Net Vulnerability Level

Figure 6.1
Wisdom's Net Vulnerability Map – Age 4 -20

and competent in pursuing engineering as a college major. She did discover the risk associated with her early schooling experiences until when she got to college and realized how underprepared she was academically to pursue engineering. Yet, her self-assurance, which was cultivated in Wisdom's K-12 years, would not allow her to quit. So she fought through her mathematics courses, starting with the lowest mathematics

course that Medium University offered, to some of the highest. Figure 6.2 below shows the risk/protective life story diagram of Wisdom's engineering life.



Solid Gray Boxes above Time Line: Protective Factors **White Boxes Below Time Line:** Risk Factors
Patterned Boxes Situated on Time Line: Serve as Both Risk and Protective Factors
Arrows: Participant Described Direct Correlation Between Factors/Processes
High Risk Factors + High Protective Factors = Net Vulnerability Level

Figure 6.2
Wisdom's Net Vulnerability Map - Age 21 -27

During Wisdom's college experiences, she felt both the "the love and the hate" from her Black college peers. This was the first time she ever recalls meeting Black people who didn't like other Black people. To counter these challenges, she sought out affirming Black organizations that cultivated her perspectives of "Black love" and "Black pride." One of those culturally affirming organizations was the National Society of Black

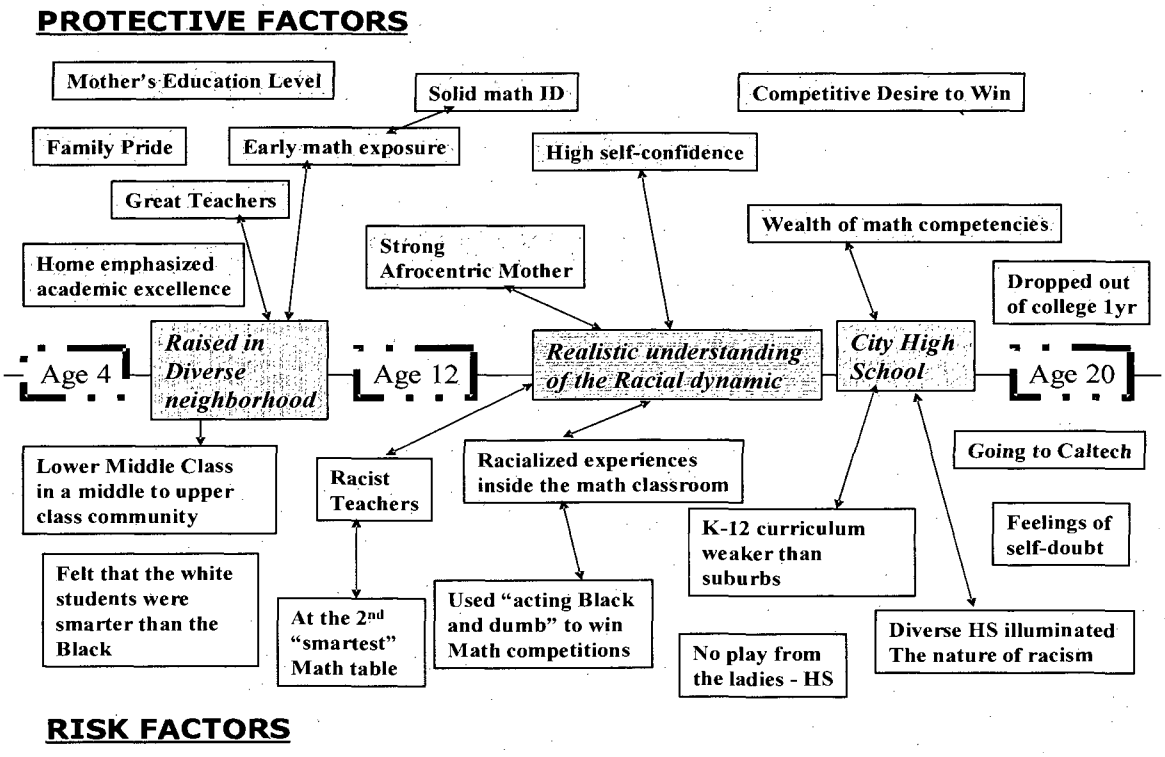
Engineers (NSBE), which, as the arrow indicates on the chart above, allowed her to secure several summer internships and research assistantships. Wisdom originally sought out NSBE because of the organization's cultural relevance but benefited additionally from its employment resources as well.

Wisdom felt a sense of pride and an overwhelming sense of responsibility to achieve in engineering to "represent" for the Black community. Although she was proud to serve as an example of what Black students could accomplish, she often felt "lonely at the top." As with the majority of the students in this study, no matter how much Wisdom achieved, she still endured subtle forms of stereotype threat, which threatened to undermine her Blackness and redefine her intellect. Wisdom decided for her own sanity's sake that she needed to ground herself by teaching younger youth of color mathematics and life skills. This way, Wisdom says, learning mathematics gave her a greater purpose and she was able to endure the racialized challenges of engineering and mathematics because her students were counting on her to succeed, to help guarantee their own mathematics literacy.

Rob's Net Vulnerability

Rob discusses how neighborhood effects played a dual role, extracting a combination of protective factors and risks factors. Rob's middle class neighborhood offered him a great deal of benefit for jumpstarting his mathematics career. His condominium complex contained a number of scientists and mathematicians, who were more than willing to satisfy Rob's intellectual curiosities. Also Rob attended a school, where the prestigious neighborhood university's children attended. He described his elementary schools teachers as excellent overall, except for a couple of racist teachers

that attempted to sabotage his mathematics knowledge. The biggest risk factor for Rob was being lower middle class in an upper middle class neighborhood. Rob became aware from a very early age that his family (his mother and brother) were disproportionately poorer than most of his friends and classmates. Rob remembers his friends having much bigger residences and he and his brother often made excuses for why after school his friends could not come over and visit. Rob's early schooling years also left him with the feeling that the Black students were not as smart as their White counterparts.



Solid Gray Boxes above Time Line: Protective Factors **White Boxes Below Time Line:** Risk Factors
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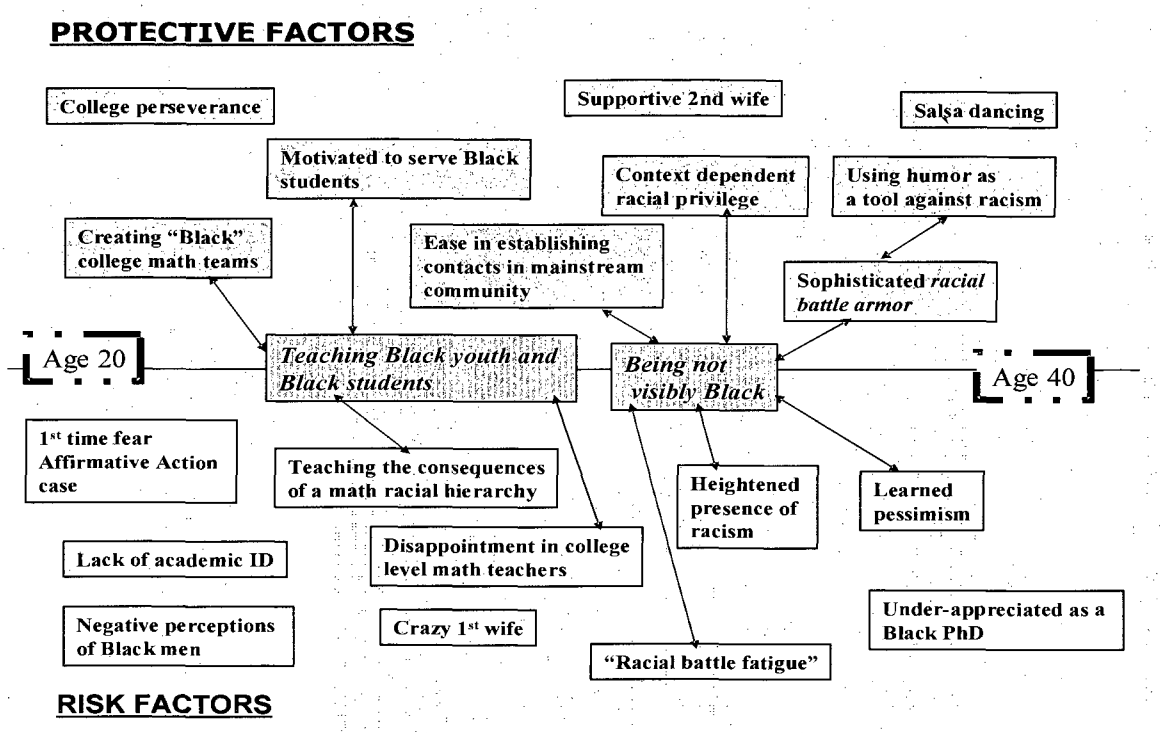
Arrows: Participant Described Direct Correlation Between Factors/Processes
High Risk Factors + High Protective Factors = Net Vulnerability Level

Figure 6.3
Rob's Net Vulnerability Map – Age 4 -20

Rob's high ACT scores and high mathematics GPA got him a coveted freshman spot at Science Tech. And although he attended what he considered a pretty racially diverse high school, Science Tech's racial dynamics rendered him one of only a handful of Black students. Rob immediately felt out of place. As he exceeded in mathematics, his science courses were harder than he anticipated and eventually Rob dropped out. He considers his attendance at Science Tech a risk factor because of his never before experiences feelings of self-doubt. Dropping out of Science Tech, according to Rob, protected his self-confidence and racial identity.

Like Wisdom, Rob found comfort in teaching youth of color. His teaching experiences both saddened him and gave his encouragement. Rob endured risk from encountering adult age Black and Latino youth who came to his classroom and could not multiply double digit numbers. Rob recognizes that "somewhere in the mathematics pipeline, someones [sic.] have failed to educate these students." Rob considered this a personal risk factor for him because he was somewhat puzzled on what to do with these students. As a result, Rob briefly left his inner-city college job to teach in a wealthy White neighborhood. Almost immediately, Rob realized that his real passion in life was in teaching mathematics to Black students. So to protect his vision, Rob left the White suburban environment to teach at an all male, predominately African American high school.

Rob feels both protection and risk from being identified as "sometimes Black, sometimes Indian, sometimes, Hispanic, and sometimes just Other." On the protective side, Rob feels that at a subconscious level he may have been able to navigate "White



Solid Gray Boxes above Time Line: Protective Factors **White Boxes Below Time Line:** Risk Factors
Patterned Boxes Situated on Time Line: Serve as Both Risk and Protective Factors
Arrows: Participant Described Direct Correlation Between Factors/Processes
High Risk Factors + High Protective Factors = Net Vulnerability Level

Figure 6.4
Rob's Net Vulnerability Map – Age 21 -40

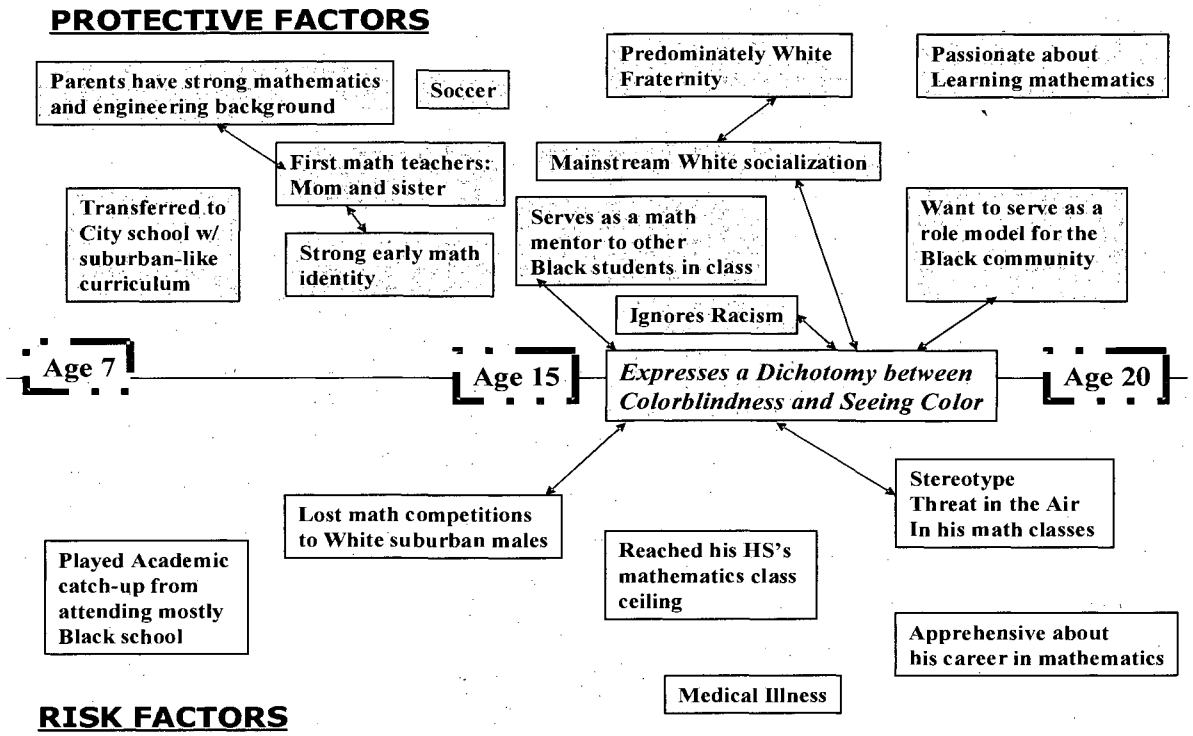
spaces" more easily than other Blacks because his father is White. Yet, on the risk side, because so many people mistake him for being non-Black, they said things to him demonstrating the true nature of their racism and belief in racial stereotypes. Rob expresses that race and racism are so entrenched in the American psyche his is pessimistic about being a change agent against racist practices. Yet, as a result of hearing "what people really think about Blacks," he has developed quite a sophisticated arsenal that protects him from personally becoming incapacitated by the disease of racism.

Cory's Net Vulnerability

Cory's protective and risk factors initially paint a simple picture of a young Black male who grew up with a lot of protective factors and low risk factors, but Cory case turned out to be a bit more complicated. Cory's protective factors were typically ones that many resilience researchers have identified: encouraging parents, good schools, early mathematics experiences, etc. Soccer was a protective factor because being a male soccer player helped him to prove himself physically while mathematics was his mental stimulation. Cory identified very few risks factors.

When I asked Cory about his life, he considered himself privileged. For Cory, his sense of privilege was developed in part, by environmental supports (e. g. middle SES, at-home mathematics tutoring, private school education) and in part by his own ideologies of ignoring racism, thereby eradicating him from the responsibility of dealing with race and his own racialized experiences. Privilege actually protected Cory form having to cope with the challenges that, say, a student like Wisdom faced. Therefore, the downside of privilege maybe his limited ability to deal with future challenges, if his privilege was altered in any way. In Cory's case, this may have created a future risk of being able to cope with challenges that privilege cannot address.

Cory's schooling experiences made it uncomplicated for him to surround himself around White, middle class males. The schools Cory attended and the tracks he tested into, along with his high mathematics achievement meant that in this racist society, by default, there would not be an abundance of opportunities to associate with other Black students. However, Cory does appear to outwardly reject opportunities to have relationships with Black students; for example he mentors the one or two Black students a year that enroll in his upper level mathematics classes. Cory may not gravitate toward



Solid Gray Boxes above Time Line: Protective Factors **White Boxes Below Time Line:** Risk Factors
Patterned Boxes Situated on Time Line: Serve as Both Risk and Protective Factors
Arrows: Participant Described Direct Correlation Between Factors/Processes
High Risk Factors + High Protective Factors = Net Vulnerability Level

Figure 6.5
Cory's Net Vulnerability Map - Age 7-27
Low Risk Factors + High Protective Factors = Underdetermined Vulnerability?

White middle class males because most of his life this is the only group he has ever associated with.

What complicates Cory's protective/risk factor chart is that he did not consider race a factor in his life and ascribed to the ideology of being colorblind, these notions help him to achieve his goals. The philosophy of colorblindness, as understood by some, is some people view being Black is similar to having a disability; it is something to be overlooked and ignored, like the stump of a severed limb or an awkward lisp. A more

literal definition of colorblindness is the removal of all cultural and historical contexts from matters of importance which allows Whites to write their own racial prejudice out of history (Bonilla-Silva, 2003). Cory had bought into the social farce of colorblindness and may have distracted him from equating colorblindness as a euphemism for blind to the issues faced by People of Color. Cory's colorblindness kept him from attempting to struggle for a more democratic social society where race disappears as a fundamental category for the distribution of power, material, and educational resources.

The conceptual shortcoming of this perspective "feeds into stereotypes and unfounded belief systems." For the three students in this case study, all showed at least just as many protective factors as risks factors, showing a healthy balance between the supports and challenges that these students face. Wisdom, Rob, and Cory, did not accept the "disparity" or "risk" label, despite the attempts by the dominant class to socialize them into accepting a risk-based fate. Furthermore, Wisdom and Rob understood the often unacknowledged privileges enjoyed by Whites and some groups of Asian students in mathematics and engineering and recognized their own resilience in understanding and developing strategies to stay successful. As mathematics educators and the larger mathematics community continues to push teachers into understanding and better appreciating the experiences of Black students, we should not ignore the ability of the students themselves to emancipate themselves from the normality of lower expectations and to perform resiliently.

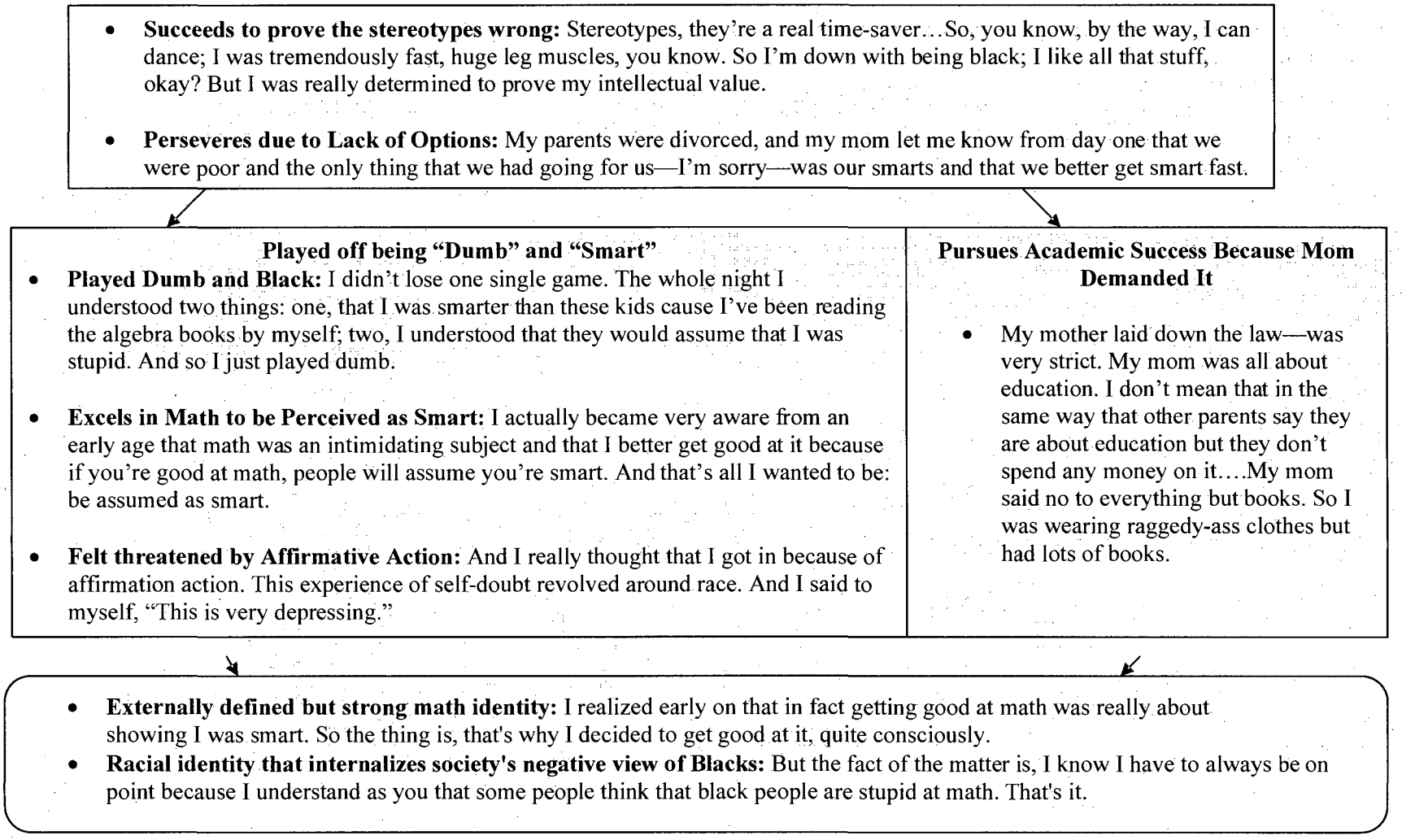
Rob's Life story

I have never been taught math by one single Black teacher. Now, that's sad.

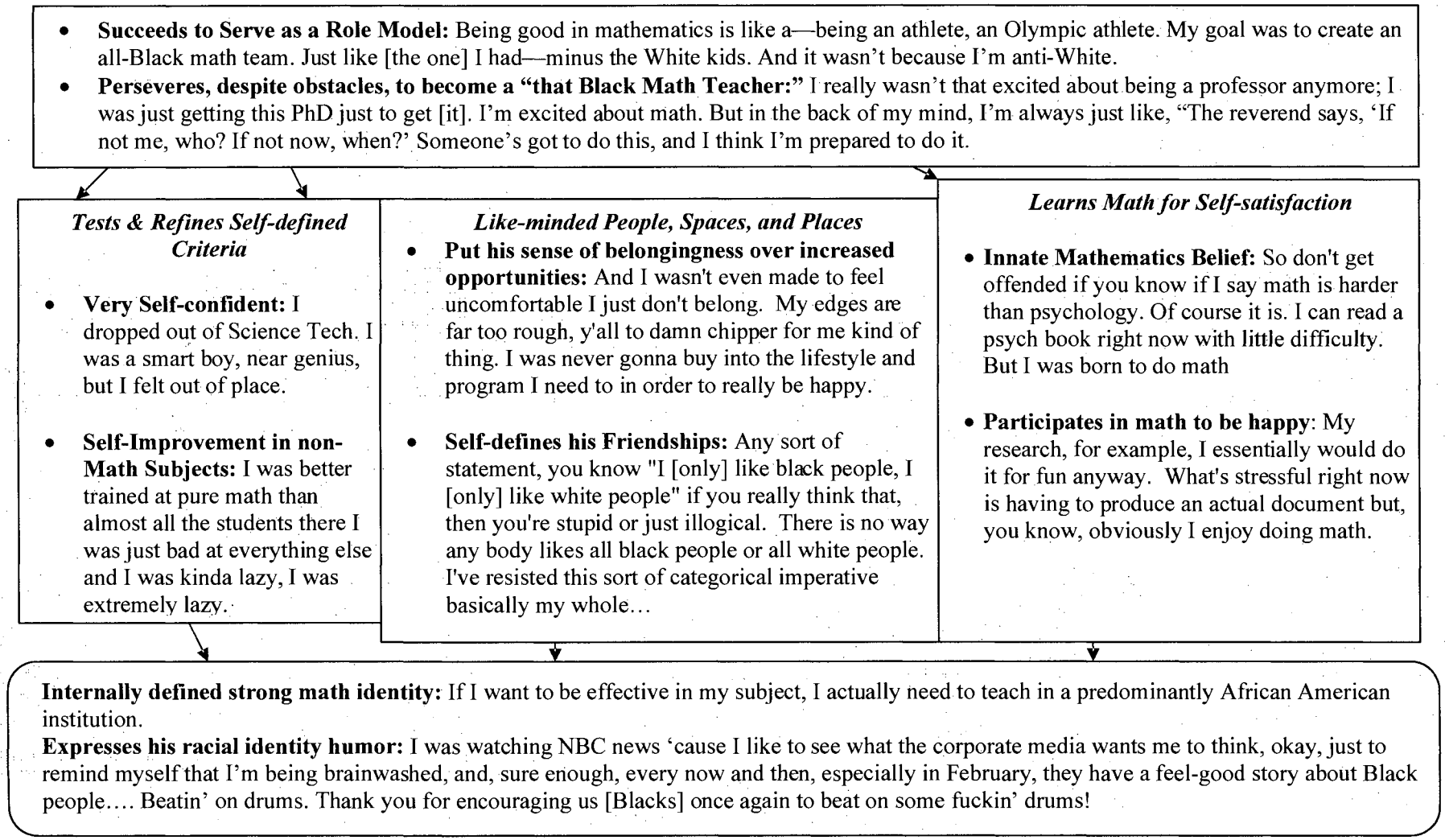
-Rob

When I first met Rob during our initial interview, he was a PhD candidate in applied mathematics. By his second interview, he had received his PhD and had been offered a job as an assistant professor at a predominately African American urban university. His achievement was particularly noteworthy because it made him one of only approximately 7 Black Americans to receive a PhD in applied mathematics in 2007. During the 2004-5 academic year, of the 1,116 doctorates awarded by U.S. mathematics departments, 434 of them (39 percent) went to U.S. citizens; the majority of doctorates were awarded to foreign nationals (Mooney & Neelakantan, 2006). Of the 434 American recipients, 380 were White, one was American Indian, 21 were Asian, 14 were Black, 12 were Hispanic, and 3 were Native Hawaiian or Pacific Islander. Seven of the fourteen Black students were citizens of African nations and the U.S.; and most had received their precollegiate education in Africa (Mooney & Neelakantan, 2006). This stark illustration of the separate and grossly unequal levels of mathematics achievement—based in part on racial disparities—makes Rob's story that much more powerful as an example of resilience and continued self-determination (Franklin, 1992) (See Figures 6.6 and 6.7).

Rob's mother raised her two sons on a single income, enduring economic hardships not uncommon in many urban, Black households. Interestingly, Rob's neighborhood was considered the most ethnically diverse in the United States at that time of his childhood, due to the presence of students who attended a prestigious university within



Rob's Fragile Form of Resilience
Figure 6.6



Rob's Robust Form of Resilience
Figure 6.7

his community. The lives of Rob's mostly high-SES White neighbors and friends presented a stark contrast to his status as a lower SES child, and this history only magnifies further the significance of his current achievements. In spite of his childhood circumstances, Rob benefited from an inner confidence instilled in him by his mother; and by age forty had acquired a breadth of mathematics teaching and learning experiences. He has taught at several private and public city high schools and summer engineering mentoring programs at urban university campuses and has also held faculty positions at both the community-college and university levels.

Rob's Early Years

Rob's mother (Candace), whom he describes as "well-educated and pro-Black," laid a strong foundation for the educational achievement of her children. Candance sacrificed expensive clothes and toys for "books, books, and more books": a no-frills plan for the success she single-mindedly pursued on behalf of her sons; and she was undeterred by her status as a single mother and the family's standing as a part of the lower middle class. Rob recalls that his mother's dream was to "have kids and get them to be as middle class as possible":

> My mother laid down the law—was very strict. My parents were divorced, and my mom let me know from day one that we were poor and the only thing that we had going for us—I'm sorry—was our smarts and that we better get smart fast. My mom was all about education. I don't mean that in the same way that other parents say they are about education but they don't spend any money on it....My mom said no to everything but books. So I was wearing raggedy-ass clothes but had lots of books. P: [00:28:22.21]

Rob credits his mother with providing "enormous support for [his] intellectual needs"; and he in turn wanted only to make his mom happy and proud of his academic accomplishments. As a result of his mom's insistence on academic excellence, Rob

achieved in a proof-driven way, throughout his school career, and although his mother has since passed away, Rob continues to be driven by her expectations.

All too often the single Black mom and the extended Black community are considered culprits in the underachievement of Black students and are assumed to have little interest in their children's education, especially if they are not involved in traditional school activities. Rob's experience counters this portrayal by demonstrating how Black single mothers can indeed have positive effects on their children's academic achievement (Sanders, 1997). Although Rob's mom laid the groundwork for his success through her high standards and commitment to his education, it was Rob learns and achieves, not only for pride and self-gratification but also for the love of learning and a desire to know more about the world.

Rob considered his elementary and high school education to be very privileged because of the schools' close proximity to a large, prestigious university, which I will call University of First Class. University of First Class was housed in a neighborhood that boasted progressive educational values, but despite Rob's racially integrated neighborhood affording him opportunities for educational advancement, it also magnified his family's lower middle class status along with their race.

Rob Interprets Mathematics as a Racialized Form of Experience

Although many of Rob's elementary and high school teachers encouraged his interests and mathematics learning, his memories of positive teachers are overshadowed by those of his racist seventh-grade mathematics teacher, Mrs. Score:

> Okay, growing up privileged in the book department, I had lots of books. In particular I had Russian series books on physics. And I [took] this book

> [to] school, and Mrs. Score accused me of stealing it. And I was just like, "What? My cousin gave this to me," which was the case...And, yeah, I was like, "Oh, my God. You can't possibly imagine that a Black kid would have this book or brown kid." 2P:[01:03:39.16]

The persistent threat of being devalued on the basis of his racial category by Mrs. Score and those of her ilk proved to be psychologically damaging for Rob (Crocker, Major & Steele, 1998; Tajfel & Turner, 1986). Yet, instead of abandoning his ambitions, Rob was able to use these racial devaluations and stereotypes as extra motivation to excel.

Rob's experiences in Mrs. Score's mathematics class at the age of twelve—particularly a painful and revelatory episode as part of an in-class mathematics competition called Equations—crystallized for him that mathematics would always be a fundamental part of his life. The game's set-up, while simple enough—groups of students, seated together at tables, solving mathematics problems—was ripe with opportunity for Mrs. Score to make plain her own biases, and she did not disappoint. Mrs. Score designated which students sat at each of the tables numbered 1 through 5 (Table 1 being labeled the smartest group and Table 5, the least smart) based on her perception of her students' mathematical intellect. Not a single Black student sat at Table 1 even though the class was over 50 percent Black. Instead, that prime position was occupied by two White, male students and one Korean student, as selected by Mrs. Score. Rob was placed at Table 2, a true sign of disrespect in his eyes, because the two White students were "totally overrated." And the stakes were high: the top two teams from Mrs. Score's mathematics class would go on to participate in a regional Midwestern mathematics competition.

All these years later, Rob relishes telling the tale of how he manipulated the White students in the mathematics competition by exploiting their perception that his Blackness made him mathematically inferior: he transformed his competitors' preconceived notions of Blacks and mathematics into a leg up for himself.

> I didn't lose one single game. The whole night I understood two things: one, that I was smarter than these kids cause I've been reading the algebra books by myself; two, I understood that they would assume that I was stupid. And so I just played dumb. Basically the whole day I overpowered them with the math meaning. And then they [Rob's competitors] would come over and say, "Judge, you know, we don't know how to do that." And they [the judges] would be like, "Don't feel bad. He [Rob has been] doing that all night long right." Or three, I would just play stupid and then let them go ahead and build a stupid solution and then go, you know, "You all shouldn't have disrespected a brother thinkin' I didn't know that." It was like, well, they're fools and thought I was stupid—too bad for them. P: [00:11:47.26]

It is obvious that, from his mathematical abilities alone, Rob would have beaten his competition handily; yet the strategy of using racial stereotypes to best his classmates—even to the point of acting as though he did not understand a concept in order to dupe his competitors into believing he was mathematically inferior—added an extra sense of justice and made his victory that much sweeter. Although the sting of Mrs. Score's racism is still fresh in Rob's mind, he acknowledges that this was a powerful impetus in his decision to pursue mathematics as a career. Rob recognized and exploited the racial stereotypes to his advantage but not without disgust over the stereotypes being so influential that he was able to get away with "acting dumb" as a technique to win the mathematics competition against seven different mathematics teams. Although Rob is now forty years old and one of approximately seven black American mathematics PhDs to graduate in 2006-2007, the fact that he could so successfully use the racial stereotype to win "still sticks in my craw."

Moreover, this period generated in Rob a "proving-them-wrong" agency that allowed him to succeed in the face of stereotypes that devalue the intelligence of Black students engaged in mathematics learning and participation:

> Two things came out: one, I was a boy, so I was competitive; and two, I understood the racial dynamic. I actually became very aware from an early age that math was an intimidating subject and that I better get good at it because if you're good at math, people will assume you're smart. And that's all I wanted to be: be assumed as smart. And I also understood that I was from a group that really wasn't representing in that department. So, you know, by the way, I can dance; I was tremendously fast, huge leg muscles, you know. So I'm down with being Black; I like all that stuff, okay? But I was really determined to prove my intellectual value. P: [00:11:47.26]

Rob does not hesitate to situate studying and teaching mathematics within the larger context of being Black (Martin, 2006a). Rather, he readily acknowledges that the peculiar and sometimes troubling nature of his mathematical experiences is predicated on the fact that he is Black and that society attaches a negative stigma to Blacks performing in mathematics. Of all the subjects comprising the school curriculum, mathematics is one that is consistently identified as representing the height of academic work: requiring the most intelligence, having the most hierarchical knowledge structure, and being most useful for distinguishing those who are deemed intellectually gifted from those who are not (Ernest, 1991). Rob suggests that stereotypes about Black educational achievement are embedded within a culture that defines his group's status and identity, against his will:

> So in American culture, the whole culture sends a signal that Black people can't do math, and the school system is structured in a way that if you're a little black kid, the teachers who tend to care about you, I'll say the first seventeen years of your life, are not always so great. So this is, of course, the problem. 2P:[00:12:49.25]

Rob not only understood this dynamic but also recognized the salience of racism in mathematics early in his academic career, and through this perspective is able to offer a

poignant and tough commentary on the racial ideology disseminated about Blacks and mathematics.

Despite his deep immersion in his own particular academic situation, Rob is not blind to the world outside mathematics; instead he recognizes that his struggle for mathematical achievement extends well beyond the school context (Martin, 2006b). Rob believes that Black students are marginalized from optimal mathematics learning experiences precisely because Blacks are often devalued in societal and educational contexts.

Rob is, by his own admission, "damn proud" of himself and his many accomplishments in mathematics and, for the most part, always has been.

> I grew up next to this Chinese family and [when] we were, like, kids and he [the Chinese father] once said to me, "Yeah, you're arrogant; you Jacksons think you're better than everybody," and I was probably seven said, "That's cause we are," [laughing proudly], which just made the guy madder. 2 P:[01:08:56.08]

While Rob recognizes that some people view his obvious pride as arrogance, he is loathe allowing their perceptions to infringe on his "right to brag." Rob feels that it is not only his right but his responsibility to show people, particularly teachers and his peers, exactly how smart he is by proving his smartness through mathematical success.

Additionally, during his schooling Rob thrived on the competitive nature of mathematics, which provided a well-respected reward system, and enjoyed the positive attention that being skilled in mathematics afforded him. The affirming feedback and the points-based reward system fueled Rob to continue his progression toward mathematics excellence. Rob also believes that his naturally competitive nature (which he feels is intrinsic to boys) helped simplify his motives for learning mathematics: he wanted to get the most points possible and stay in the lead in all mathematics

competitions. Eventually, Rob's singular resolve to win gave way to a love for the beauty of mathematics, and he sought out the long-term investments it would take to be successful in it.

Rob's Racial Identity

The way in which this relationship between racial identity and mathematics and engineering achievement was explored through the MIBI, focuses on the factors of racial centrality, public and private racial regard. To recap, racial centrality refers to how important race is to a person, and whether the individual thinks it is important being of a certain race. Public regard looks at whether the individual thinks this country and its population looks favorably on their race. Finally, the last factor, private regard, asks to examine the importance of whether an individual feels good about being of a certain race.

(MIBI: Range 1 to 7)

Centrality:	4.785
Private Regard:	5.333
Public Regard:	1.500

The results show that Rob has an above average centrality score, very low public regard and but high private regard. One way to interpret his success is that the low public regard means he has to work twice as hard and be "twice as smart" to succeed against the obstacles he faces because of the perceptions associated with his race. Rob challenged these obstacles with mathematics success. Rob strongly believes that society disvalues Blacks. When asked about his centrality score Rob determined that is was not higher because the value of pride he has for his family, which he coins as "family identity:"

> I think ethnic pride is illogical. Black pride, Black shame. White pride, White shame. I was taught that [I] should only have pride for the individual stuff that I do. But I have personal and family pride for mathematics. 2 P:[00:16:17.27]

Although Rob had theorized on racism for practically the entire first interview, when the idea of racial *identity* was introduced, Rob immediately exclaimed that it was a personal issue—not one that researchers can theorize about and disseminate as truth. He went on to argue that the notion of ethnic pride was irrational.

Rob describes himself as an "NVB" which stands for *not visibly Black*. His mother is Haitian, and his father is White; and people often identify him as a "dark-skinned Indian or Latino depending on what part of town I'm at." During his early years, Rob derived solace from a set of racially diverse friendships, gravitating toward individuals whom he described as "unique and original." Although most of his friends are now Black, he cultivates his friendships by tuning into a sense of belonging. Growing up in an ethnically diverse neighborhood and choosing friends who were self-defined made him feel secure in his own individuality:

> I mean, most of my friends were Black, and I wasn't even thinking about, I didn't even realize it. But the leader was actually a White guy that thought he was Black, okay? My little social group was a bunch of Black kids led by this guy who we would all call a Wigger [White nigger]. He was our leader, but actually we all went to his house because he had the big, old, giant house. You know the ironic thing is that he's old-school White money, but somewhere, some wire got crossed. I sound much Whiter than he does, and back then I used to [think] to myself, "Okay, we're by ourselves; you can act White now," but that's who he is. So, in fact, no, I didn't feel any need to hide my Blackness. This White boy was Blacker than me. 2P:[00:51:03.02]

The leader of the Wiggers was White in ethnicity, but in Rob's view his soul was Black; thus Rob could relate to him and feel comfortable in expressing his own Blackness. Rob's speech mimicked the speech patterns of mainstream culture, and he recognized that he benefited from being able to "talk like that."

While Rob readily identifies himself as Black, he also understands that being partially of White parentage has provided him more leverage than most of his Black peers born to two parents of African American ethnicity:

> I actually did not realize until I was much older that maybe I am able to learn from these White guys 'cause my dad is White and at a subconscious level this guy is not threatening me unless of course he's obviously a bigot. Subconsciously I may have an advantage and it took me a long time to realize there goes another niche. Number one, I'm a stealth Negro, you know what I'm saying? People don't think I'm Black, right? My whole life is "No, you're not Black." If they're Black or if they're White, it's like, "You're not really Black, right?" P: [00:32:07.24]

Being "not visibly Black" conveyed certain advantages to Rob because some of the perceptions or stereotypes that are readily attached to "Black-looking people" were not immediately or naturally attached to him. When teachers or peers did discover that Rob was indeed Black, they for the most part still treated him like an anomaly: "You don't really act Black or look Black." While Rob still encountered all sorts of racism (covert, overt, everyday, etc.) as a "non-Black Black man," yet it was often directed toward his racial group without the perpetuators knowledge that they talking to a Black man. Instead of internalizing and being debilitated by these racial experiences, he actually developed a greater sense of urgency to teach Black youth and a sense of the importance of learning mathematics as a way to prove one's equality.

Rob's College Experiences

While Rob's early experiences with mathematics had sparked and fueled in him a high degree of confidence, his attendance at the Science Institute of Technology (Science Tech) ushered in a jarring and unexpected period of self-doubt. Although he never denied his "super powers" in mathematics, he decided to major in physics and was "forced" to enroll in some required non-mathematics and science classes. During his

interview, Rob admitted to being lazy in most of these classes; and as his grades suffered, his self-esteem slipped, too, causing him to doubt himself and question his admission to Science Tech: was he simply an "affirmative action case"? Rob described this as the only time in his adult life that he seriously doubted his educational and intellectual abilities:

> [At the time I thought] I probably got in because of affirmative action. I had fantastic scores in math; I took math at the University of First Class when I was in high school. I mean, I'm not kidding, you know. That's how good I was at math. That's all I do. And yet I was pretty lazy at everything else and not particularly prepared. So that was the first time I doubted myself. And I began to realize, "Well, I didn't get in here because I was smart." And of course I did. Of course. P: [00:38:01.18]

Rob—like just about every other student in this study—described bouts of self-doubt which stemmed from his suspicion that affirmative action policies had provided him with a "handout" (Blanchett, Mumford, & Beachum, 2005). The negative connotations associated with affirmative action created a pattern of negative racial attitudes that Rob started to internalize:

> I dropped out of Science Tech. I was a smart boy, but I felt out of place. And I wasn't prepared in anything other than mathematics. I mean, my math scores were off the hook, and, I mean, clearly I was a talented young man. This is first time I doubted myself. And I really thought that I got in because of affirmation action. This experience of self-doubt revolved around race. And I said to myself, "This is very depressing." P: [00:03:25.05]

Rob's mathematics self-esteem remained intact, but in order to preserve his racial self-esteem, he dropped out of Science Tech and moved back to the safe haven of his childhood neighborhood, taking an entire year off school and, as he described it, "wander[ing] around." He has no regrets about leaving Science Tech, however, because that year was critical to rebuilding his racial self-esteem. Rob eventually received three

master's degrees—one in mathematics, one in computer science, and the other in teaching mathematics—as well as his PhD in applied mathematics.

The particular constraints unique to Black male youth—distinct even from those affecting Black women—are also of critical importance to Rob. He feels that the differential treatment that Black males experience often leaves them resentful of White institutions where success is predicated on assimilation practices. Negative experiences in these contexts can contribute to many Black males viewing school as a hostile environment and feeling frustrated in their academic efforts regardless of whether they disengage or achieve in school. According to Rob, teachers' fear and prejudice limits the potential for Black males to get the educational assistance they need to succeed in the classroom: "The teacher can't teach somebody she is afraid of." Rob explained that instead of receiving instruction and an academic education, these young Black men are more likely to face detention and other sanctions for transgressing or being perceived as transgressing school norms.

Development of Rob's Social Identity

Rob understood the very real and acute pressure many face to define themselves through what they can buy; he even admitted to briefly going through that phase himself, shortly after starting his first "real" job. Now, however, rather than basing his self-concept on material possessions, Rob defines himself by his own personal criteria, developed in part as a result of his mother's principles and influence. Rob puts his money and personal assets toward intellectual development and not "stuff that makes people feel good about not knowing and not doing," thereby rejecting the notion that what he can buy makes him who he is.

Rob dismisses the notion that being *Afrocentric* (defined in the literature as a means of putting Africa at the center of one's being, the total use of method to affect psychological, political, social, cultural, and economic change (Asante, 1991)) the means buying a select group of highly visible items, advertised by those who define what it means to be Afrocentric. For Rob, cowrie shells, mud cloth, and a HBCU University sweatshirt do not an Afrocentric identity or worldview make. Calling oneself "Blacker" and "better" than the next person who does not have these accoutrements portrays a false sense of being Black:

> We are all essentially taught to define ourselves by what we consume, right? The culture first defines who you are and tells you to buy this. So when most people, when most people think I'm going to embrace Afrocentric values, they are unfortunately not thinking about reading certain books. 2 P:[00:04:11.24]

Although Rob dismissed the idea that overt displays of Afrocentricity are a valid a way of "proving your Blackness," he seemed conflicted about how his culture has been defined. Rob vehemently insisted that Whites believe that the role of their culture is to provide the "cultural rubric" for all people—especially African Americans. As a result Whites maintain entitlement for most social opportunities and rewards of privilege, such as quality educational institutions and cushy jobs, and a disproportionate opportunity to accumulate wealth.

A consequence of Rob's extensive struggles with certain aspects of being a Black mathematics student is that he has become particularly adept at employing humor and satire to reject racism and guard against racial stereotypes:

> Stereotypes, they're a real time-saver. And you know the *Onion* [satirical magazine] goes through the humor gets to some truth, that's probably why we are all stereotype. And when people say, "I'm not racist," or "I don't stereotype," they're either stupid or full of shit—of course they do. The problem is some people's stereotyping algorithms are extremely unsophisticated, which is to say: they look at me and, "He's Indian; he's fine." And then they look at someone

> who's Black or lookin' at me and, "Whoa—he's a threat, okay?" You know, the brother may have a PhD from University of First Class And you will hear stories about [how] Black students at University of First Class always felt like they were mistrusted, you know; they would walk past a car—[the car lock goes] click—you know, that kind of thing. P:[00:53:17.28]

Rob's wit serves as a vehicle for the assertion of a positive yet realistic racial identity. Being extremely well-read, he can easily incorporate humorous, racialized perspectives from a variety of sources—media, educators, sociologists, psychologists, and their critics—to make light of the dynamics of race. And his humor can be traced to a broader phenomenon: Black speakers and comics celebrating their identity by telling jokes in which race and racism are highlighted (Fulton, 2004).

Rob's Future Aspirations

Rob's desire to increase the mathematical literacy of African Americans is a major driving force behind his aspirations for the future. Years spent teaching at a number of educational institutions have served as both a source of personal strength and a perch from which to witness how racism works to deprive Black and brown students of educational equity. Rob believes that his greatest good as a teacher is to teach and inspire Black students to become mathematicians. His dream–one he had almost given up on—is to create a winning all-Black math team. He makes no apologies for this:

> Being good in mathematics is like a—being an athlete, an Olympic athlete. You have to train. But you can't train without good trainers. And even the best swim coach can't teach his students how to swim without access to a pool. My goal was to create an all-Black math team. That's all it was. Just like [the one] I had—minus the White kids. And it wasn't because I'm anti-White. P: [00:32:07.24]

Although he has taught at very prestigious suburban schools, Rob found they were missing one important element that drives his teaching pedagogy: Black students. His excitement and zest for teaching does not come from the pay or the decent hours, but

from the sense of responsibility he feels for educating underserved Black youth. With this as his motivation, Rob sought out mathematics teaching experiences that would have the greatest impact in educating Black youth. Rob, after teaching at various institutions, from a suburban, mostly White prestigious high school to a majority Black community college he feels most inspired when he is teaching mathematics to Black youth:

> For an educator who wishes to kind of have a high-end math impact, I really think they should teach in an all-Black institution, okay? And I hit upon this solution as my initial solution, which was when I did my student teaching at [an all-Black high school institution]. All Blacks—so none of that "it's a White thing; it's an Asian thing to do math"; and I was very happy with the results. And in fact [before that particular teaching experience], I really wasn't that excited about being a professor anymore; I was just getting this PhD just to get [it]. And it's, like, math, and I'm excited about math. But in the back of my mind, I'm always just like, "The reverend says, 'If not me, who? If not now, when?'" you know? Someone's got to do this, and I think I'm prepared to do it. P: [00:32:07.24]

Rob is so adamant about teaching mathematics to Black students because he knows he can inspire a drastic shift in how these students picture success by introducing a perspective and an example that are radically different from what they are used to. He believes that creating successful Black mathematics students requires exposure to successful Black mathematics teachers like him who care about the education of Black students:

> So I'd hate to say it, sadly, but what you need is a visible success. A visible success with a group of young Black students beating other students, preferably not Black, you see what I'm saying? It's that simple, right? And it's not 'cause I don't like the other students, it's just a means to an end. In fact, most of my career—I've been educating non-Black students most of my career, in spite of my efforts to do the opposite 'cause the reality is there are very few efforts to mathematically educate Black students. 2P:[00:26:28.15]

Rob chose to leave his high-salary teaching position at a predominately White high school for a lower-paying mathematics teaching position at predominately Black, all male high school. Rob discusses his reasons for leaving the predominately white school:

> This was actually a very good school, I was actually making a very good salary and in fact, I even liked it. But I would of had to literally sublimate myself in order to be happy in the long run. There was a constant nagging thing that "nope, what the fuck are you doing here?" But actually again, I liked it. Teaching rich White kids who are trained to soak up whatever you tell them, it's easy and it's fun, okay? You know? Don't kid yourself there. I knew, I just didn't belong. 2P:[00:31:47.23]

Although Rob experienced no overt threats against him, he did express an eerie uncomfortableness associated with him being placed in a mostly White environment. The benefits of securing a coveted teaching position in this notable high school did not outweigh the awkwardness of being the "only Black teacher in the school, besides the gym teacher."

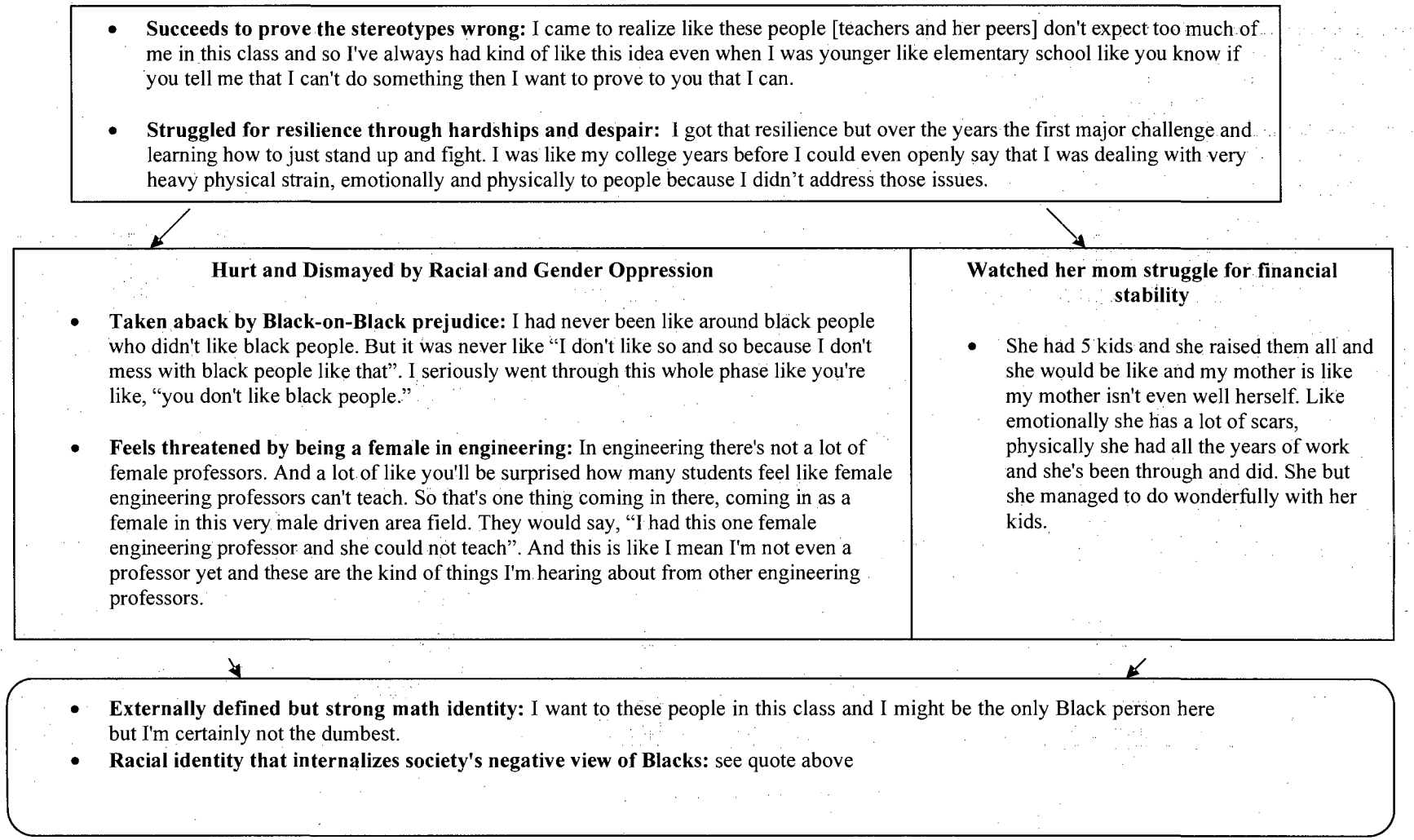
Rob recognized that his struggle for mathematics achievement extends well beyond the school context (Martin, 2006a, 2006b). Yet he has rejected the notion of intellectual inferiority based on race and believes that Black students are marginalized from optimal mathematics learning experiences because they are often devalued in societal and education contexts.

Rob also made the connections between mathematics as an area of study and the larger issues of unequal economic, political, and cultural power. Rob is a racial realist because he looks at racism both realistically and critically (Bell, 1994). Rob's experiences speak frankly and boldly about racism, which makes his story of special value in confronting racism, classism, and the unique experiences that Black men in America endure.

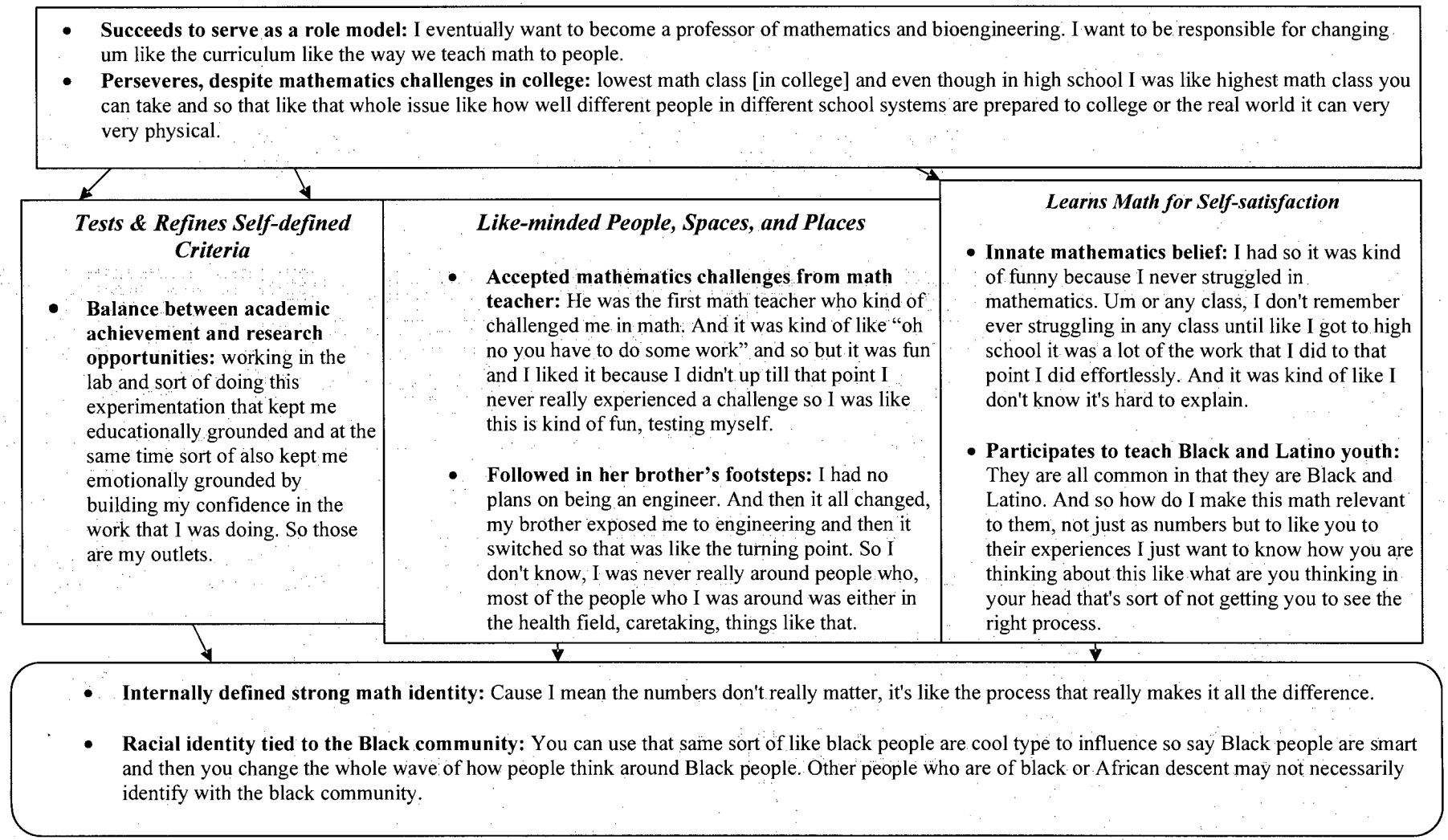
Wisdom's Life Story

At the time of our first interview, Wisdom was just months shy of graduating with her master's in bioengineering from Medium University. She was also employed part-time at a progressive youth program that was founded on the mathematics teachings of the civil rights movement. Although Wisdom was suffering with a bad cold during our first meeting, her warm disposition and calm demeanor were immediately evident; and due to her interest in pursuing a PhD in mathematics education, she was just as interested in talking to me as I was in talking to her. Despite being relatively young (twenty-seven), she was very knowledgeable about the social, educational, and economic concerns facing youth of color.

Wisdom's story, like those of so many other successful Black mathematics students, is one of resilience against life and educational obstacles. Wisdom and her five siblings were raised by their mother in a Midwestern city where over 80 percent of families live below the federal poverty line. Although her family experienced significant difficulty, Wisdom found a wealth of fulfillment in their love, support, and strength. In contrast to the standard perceptions of the hardships associated with an upbringing like hers, Wisdom's journey demonstrates the protective factors associated with being raised in an extremely poor, predominately Black city—that is, the "good in the 'hood": she managed to escape the blatant forms of racism she might have endured without the shelter that being surrounded by her own offered (See Figure 6.8 and 6.9).



Wisdom's Fragile Form of Resilience
Figure 6.8



Wisdom's Robust Form of Resilience
Figure 6.9

Wisdom's Childhood Experiences

Wisdom grew up in an "all-Black community (except for the gas stations' and convenient stores' owners)" that she describes as a "Blackout." The city was once home to one the largest concentrations of industrial production in the United States; however, most of the companies that formed the nucleus of this industry deserted the city long ago. Descriptions of Wisdom's community portray the bleakness of the landscape in no uncertain terms, referring to "unemployed blue-collar workers living in the midst of polluted skies, garbage dumps and violent ghettos." (Dorson, 1981, pg. 235) Yet for Wisdom, living in the projects of this city had its advantages. Although her early childhood was riddled with economic despair, during her K-12 years, Wisdom was buffered from the overt forms of racism that often plague Blacks who live in racially mixed or predominately White neighborhoods.

Wisdom's mother found work cleaning a "White lady's house" during most of Wisdom's childhood, and Wisdom has harsh memories of financial struggle. As a result of the evils that financial poverty often brings (for example, house robberies, early exposure to drug-addicted people, and sexual abuse.), Wisdom developed early feelings of anxiety and fears of being ill-treated. Wisdom's family was "constantly moving" within the city limits, but they never relocated into neighborhoods where her mother could say, "Oh, great, just go outside and play."

> I can remember, like, being awoken in the middle of the night and just some random crackhead banging on the door, like, trying to come in, you know? We were always getting robbed. I can remember living in a house where the basement—you could see all the way down from the top floor into the basement 'cause there was a huge hole in the floor. P: [00:35:41.18]

Wisdom's mother spent most of her life working several jobs at a time trying to provide a better life for herself and her five children; Wisdom calls her the "strongest

person I know in the whole wide world." Her mother's perseverance in working to support her family was a constant and clear lesson in living for Wisdom: strive constantly to achieve something better. Wisdom credits her mother for teaching her how to negotiate some of life's challenges through an understanding that family is the biggest source of support one can have.

The entire maternal side of Wisdom's family lived within a three-mile radius of her, and she describes her family as "close-knit and emotionally strong." During Wisdom's childhood, her grandmother's home was the one house that remained constant and served not only as the place for all family gatherings but also as a source of strength and endurance. Wisdom's older brother was an engineering major, so early in her educational career she benefited from having encouragement to pursue engineering and an out-of-school support system. Wisdom said what she benefited most was from knowing exactly what engineering was and it's many possibilities. With her brother's informal teachings, engineering become less abstract, more real, and more tangible in her life and her academic goals.

While Wisdom's family was a constant source of strength and encouragement to her, their constant relocation due to her mother's unstable employment situation was a particularly difficult aspect of her childhood. She attended six different schools during her elementary years; so until the sixth grade Wisdom was always "the new kid in class" and she discovered that "fighting the new girl" was a disturbingly common recess pastime. Wisdom remembers second and third grades as the best time for her during her elementary years because she attended the same school continuously, the longest time she was in one school. Despite the difficulty, the turmoil in Wisdom's life did not appear to negatively impact her educational outcomes. Wisdom found that she was "naturally

good" at school; it was the non-academic aspects of school and life that caused her the most grief:

> The first major challenge and learning how to just stand up [for myself], and I didn't even stand up to my first bully until I was in the seventh grade. The other challenge was building my own confidence and my own self-image. People don't like the project kids in school; and the project kids are always dirty and this or that and having to deal with a lot of those challenges, like, just within myself to be, like, to really see myself...as beautiful and intelligent and things like that. And so, and then, as far as physical challenges, like, just the idea of being comfortable with—just around people—'cause over the years there were a lot of different things that happened to me in my life in addition to being afraid of society and being a part of society. P: [00:31:29.16]

The hardships of Wisdom's early childhood years took a heavy emotional toll, and for years she unsuccessfully attempted to erase these experiences by blocking out painful memories. Since college, Wisdom has come to realize that only through remembering and slowly healing from these tragedies will she ultimately become stronger.

Wisdom's Racial Identity

Wisdom possesses a high degree of racial pride, consciousness, and awareness, as indicated through her interview statements and the results of her MIBI. Wisdom possessed a strong sense of pride in her identity as a Black person. Race-specific private regard typically has a moderate to strong positive correlation with psychological health (Sellers et al., 2003). As Wisdom and I discussed the MIBI and her personal results, she felt that her 7.00 out of 7.00 score for private regard allowed her greater self-esteem, superior psychological health and strong self-efficacy. Wisdom further suggested that her racial pride is also tied to being resilient against racial discrimination, particularly those racialized incidents she experienced with other Black college students.

(MIBI: Range 1 to 7)

Centrality	6.375
Private Regard	7.000
Public Regard	2.333

Wisdom's low public regard score indicates that she is aware of the devalued status her group endures and this actually helps her cope with experiences of discrimination. Wisdom realizes the low expectations that many teachers, students, employers, and society as whole, and the anticipated expectations of rejection actually serve as a protective factor against her psyche. Wisdom has learned to expect racial stereotypes and copes at first by attempting to prove the stereotypes wrong and eventually decided not to care "too much" about what other thought of intellectual competencies. Yet, the expectation of racial discrimination does come with anxiety and psychological distress for Wisdom. She feels like a walking poster-child for perceived inferiority although she had satisfied all the typical conditions of academic success. Although she does not necessarily internalize the negative perceptions that others hold for her race she does experience internal distress.

Wisdom's racial centrality - the extent to which she normatively defines herself in terms of race – was a 6.375, the highest score of all the twenty-three students. Wisdom proudly invokes her centrality in her style of dress, natural hair style, club affiliations and social activities. Being Black is fundamental in how she views the world and in determining her future goals. The MIBI confirmed Wisdom's descriptions of her Black pride and unconditional love for the African American community. Wisdom has also developed very personal notions regarding the potential for social change and has

gained a greater sense of her power to control her own destiny and impact the destinies of her racial group:

> And they're [her younger cousins] always call[ing] me a "Black activist," which, I mean, I can't help it. I figure if I'm gonna do something, and I like to help people, and it should be Black people. And not that other people are less important at this particular point in time, but Black people are the ones [in] need of help; so now if the paradigm changes, and Black people are all good, and, you know, we're doing all well, then maybe I'll focus my attention on someone else and other people. But until then I'm gonna be fighting for Black people.

Wisdom's future plans are directly related to the interplay between the centrality to her race and the love she has for herself as a Black person (private regard) with the realities of the racism and racial discrimination Black people endure (public regard). Her keen awareness of structural constraints that exist for aspiring Black mathematics students comes from her own experience and the continued struggle she witnesses in teaching mathematics to Black and Latino youth. She plans to enroll in a mathematics education doctoral program and become a mathematics education professor to challenge the ways in which Blacks are taught mathematics as well as the norms and expectations of schooling, which privilege White and individual identities over Black and collective identities. Her level of Black self-consciousness empowers Wisdom to believe she can affect the academic and mathematics self-efficacy beliefs of Black students.

Wisdom's College Experiences

College offered Wisdom a host of new racialized experiences both inside and outside the classroom. During her high school years, along with being raised in a predominately Black setting, Wisdom had incorporated Black-centered principles into her lifestyle; she was already a mentor and role model for Black youth and increased knowledge of her culture by reading books from "all over the African Diaspora." During her first few

months at ethnically and racially diverse Medium University, meeting and connecting with people outside of her race were surprising delights. However, Wisdom soon realized the campus's racial diversity went hand in hand with racial isolation. Although there were many ethnic cultures represented at Medium, students from the same racial groups mostly stuck together and rarely interacted with students from other racial backgrounds. Wisdom's interactions with African students, whose very countries she had studied as a source of racial pride in high school, left her additionally dismayed. She despaired at experiencing Black-on-Black prejudice from college students of African descent, some of whom had grown up in countries other than the United States. All of this left Wisdom "not feelin' good" about herself.

Despite the fact that Wisdom has a pro-Black racial identity, she experienced great despair over the notion that some black students did not like their own skin:

> The one thing that was eye-opening when I came to Medium was I had never been, like, around Black people who didn't like Black people. Black people who were like, "I don't mess with black people like that." And, you know, I think that was, that for me was like, "Wow! These [Black] people were like, 'I don't hang out with black people; I don't date black people; I don't do anything that have to do with Black people." I was like coming from [predominately black city] where it's just Black people. And it was like . . . and it started to really take a toll on me. So I took a step back, and I observed for a minute, and then I started, like, reentering the black community. But for a minute I couldn't handle it. P:[00:14:47.00]

Wisdom never thought of using her dislike of a few Black people in her home neighborhood as a reason to denounce her entire race. Initially Wisdom, truly troubled by these students' ideologies and explanations of Black students who avoided most Black people, dissociated from all extra-curricula activities on campus. After a few weeks of reflection, Wisdom immersed herself in the pro-Black part of the Black community at Medium. Black poetry sets and the Black Student Union became safe

havens and were in Wisdom's words a "saving grace." Six of the students in this study discovered that a few Black students appeared to accept certain stereotypes about Blacks and as a result "did whatever it took" to distance themselves from those perceptions.

Wisdom found herself less prepared than her peers at Medium University. Although she graduated at the top of her high school class in her hometown, Wisdom was placed in the lowest mathematics class at Medium- a class usually reserved for students who are assessed as needing remedial training in mathematics. Her placement in the lowest mathematics class at Medium did not deter Wisdom from pursuing her engineering degree:

> It's tough because when I first came to Medium one thing I realized was how ill prepared I was. Even though I was like at the top you know back in [my hometown] in my school there was when I came to Medium, I was at the bottom. I was starting in like the lowest math class and even though in high school I was like highest math class you can take and that like that whole issue like how well different people in different school systems are prepared to college or the real world it can be very very physical. I wasn't until my third year that I was in honors math classes. I was in the honors college and honors math and honors physics and all these upper level classes. I would come into these classes and I would literally be like the only black female there and it was I think there was one other African American male and one of my math classes. P: [00:23:10.19]

Wisdom unwavering persistence allowed her to obtain her BS in biomedical engineering in four years, despite a high school math curriculum that caused her to be initially underprepared.

Wisdom's involvement in Black student organizations helped to generate a sense of purpose, affiliation, and meaning. For educational grounding, she found solace in performing experiments in the science and engineering labs and in working beside her professors and peers, which provided the added benefit of building confidence in her engineering pursuits.

Wisdom's Racialized Mathematics Experiences

Being placed in the lowest level mathematics class available at Medium shocked Wisdom into realizing just how ill-prepared she was in mathematics. Having come from the highest mathematics class in her high school, Wisdom took issue with the differences in opportunities to learn mathematics between the schools in her community and the communities in which other Medium student's had grown up—discrepancies which are often dependent on the economics generated by a school's neighborhood. This became "very, very physical"—that is, exceedingly evident—to Wisdom as she progressed from the lower-level mathematics classes, which contained mostly Black and Latino students, to her higher-level mathematics classes, where she was frequently the only Black female student.

In these advanced classes, Wisdom perceived a "threat in the air"—that of being labeled an "affirmative action student"—and realized just how much of a stigma of perceived inferiority is associated with Blacks pursuing engineering and mathematics degrees. When Wisdom walks into a classroom she feels as though she is being viewed as a less qualified student who got into college based on her race. She believes her predominately White and Asian classmates may feel that she took a slot away from a more deserving White or Asian student. As a Black student in a field with very few Blacks, Wisdom is subject to being judged according to her status as a member of an ill-regarded minority group rather than as an individual. Wisdom has felt the responsibility to "be on point" (that is, to perform at a consistently high level) academically to combat others' perceptions not only of her but also of "the next Black person in the class."

> [B]y the time I was in my upper-level classes, I was, like, unstoppable. Folk would say, "Let's do a study group," and I was like, "Okay, I gotcha on that." And it felt so good. I guess partially because I don't care, but also I don't want these people to think bad of me and, like, 'cause if they do think bad of me, then I'm the person coming to their class, so I, like, really, really made sure that I was not at the bottom. [If] I answered one question wrong, I knew they would say, "Look at this girl. Affirmative action: I know that's how she got here." And so the fact that people asked me for help was like, was like the icing on the cake, and I was like, "*Yes!* I'm the only Black person in this class, and I got the highest scores on exams. So *boo-yah!* I knew that I could do it." P: [00:28:40.20]

Wisdom highlighted that her college mathematics and engineering classes employed too narrow a teaching and learning mode and that students with other strengths found little opportunity to use the skills they learned elsewhere, particularly their verbal skills, in making sense of the material (Tobias, 1990). To counteract this shortcoming, Wisdom wants to create a mathematics curriculum that pulls from the plentiful resources existing within students' home communities to provide greater support and excitement. Utilizing mathematics and engineering teachers who believe in the abilities of Black students is also of critical importance to Wisdom. She related an episode from one math class that left little ambiguity regarding the low expectations some professors hold for their Black students:

> This was Math #—calc, calculus—so he's [the professor is] throwing out questions, and kids are answering. And this [Black] guy, Prince, he answers one of the questions, and the professor literally stops class and says, "Wow, that was right." He was, like, really shocked that this guy got it. And so that kind of, like, threw me for a loop, and I came to realize, like, these people don't expect too much of me in this class. And so I've always had the idea that if you tell me that I can't do something, then I want to prove to you that I can. And so, for the rest of the time in all my upper-level classes, that was my goal. I want these people in this class [to know that] I might be the only Black person here, but I'm certainly not the dumbest. P: [00:25:33.17]

Wisdom not only has to deal with the stigma of inferiority and take extra measures to "prove" her intellect but she also must contend with the fact that her field (bio-

engineering) has even fewer Blacks than other engineering disciplines, such as mechanical or electrical engineering. When Wisdom received her undergraduate degree in 2004, she and two Black master's degree recipients were the only three Black graduates in the bioengineering field that year.

Wisdom's Future Aspirations

During her interview Wisdom discussed the vulnerability of Blacks in math and engineering professions. Wisdom was troubled by the fact that her outstanding academic progress and engineering pursuits were not guarantees of secure employment opportunities in the face of discriminatory hiring practices. The anticipation of her master's degree in bioengineering would offer no real protection from racialized employment situations. Wisdom also discussed the challenges she expects to face as a professor: "When I become a Black female engineering professor, people's preconceived notions are always going to be there. That's not something we can change." Wisdom feels that because of her race her career will always be threatened and her degree will be undervalued in comparison to those of others in her field.

Wisdom's story offers a powerful rebuttal of the conclusions that have dominated this field of study over the past twenty-five years. Conventional research predicts that a student like Wisdom will underachieve in engineering or drop out of the field entirely. But Wisdom did achieve, all while not "acting White" but instead thriving within a "Black cultural frame of reference." She has developed a strong Black identity and has come to recognize social inequalities and the existence of differential rewards and opportunities. Wisdom's personal encounters with racial discrimination and social class inequalities heightened her recognition of racial and class barriers. In addition, her kin's openness in

speaking of their own experiences of racial discrimination afforded Wisdom vantage points for interpreting the salience of racial and social class factors in the pursuit of mathematics literacy.

Wisdom's dream job, which reflects her concerns and perspective, is quite unique:

> I would own a business. A company specifically that designs orthopedic devices specifically to integrate into human bodies. And then I would have those [proceeds] from the company, um, go to—some of the money that I make go to building a school for black youth to become successful without ignoring their own culture. So, say I am successful; ideally, I mean, I'm the number one in the country. Hopefully, all-Black engineers—just to kind of put the idea out there, you know...'cause I think, like, Black engineers, you know, are shoved under the carpet sometimes. P: [00:47:22.07]

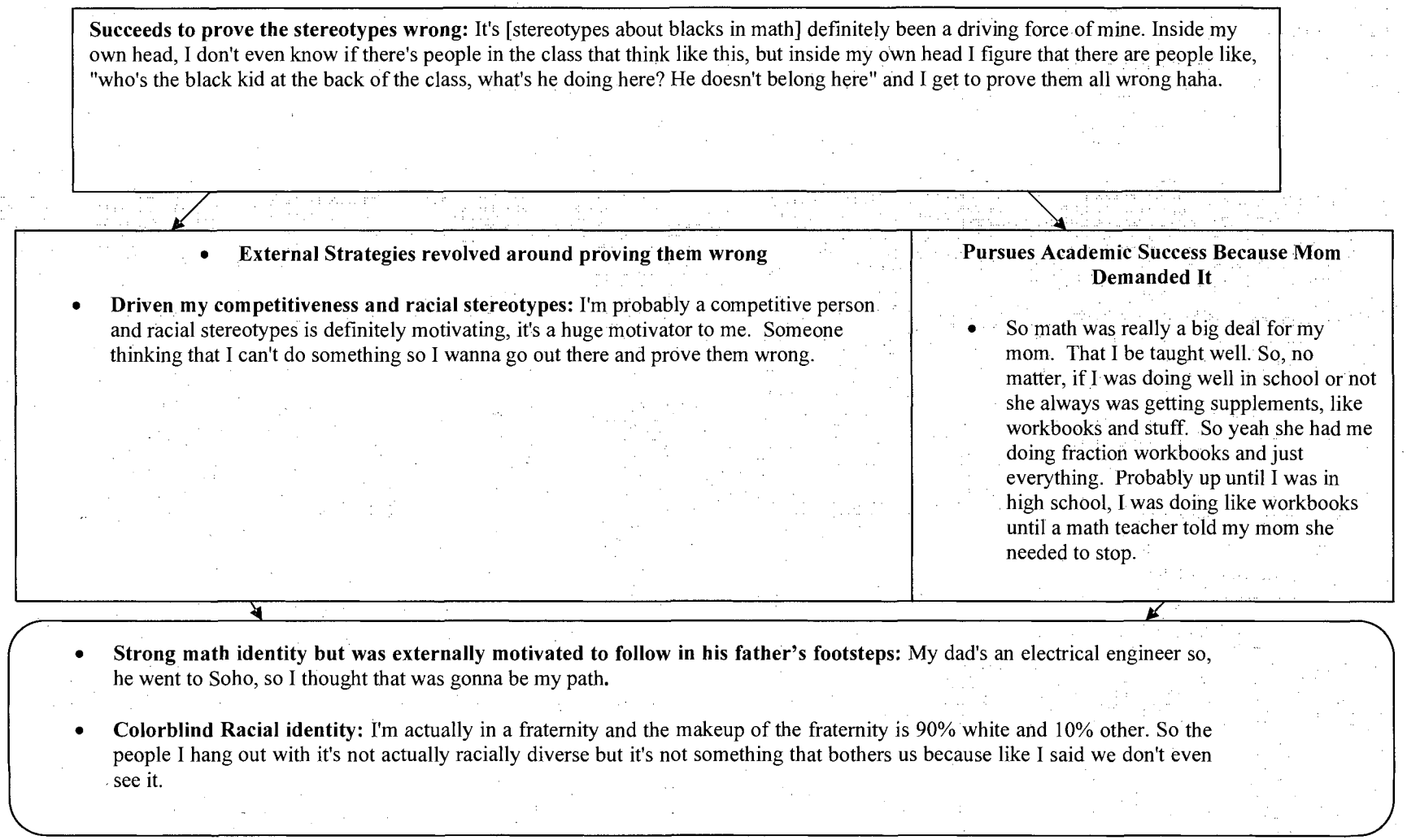
The proceeds from her business would go into caring for her family and starting a culturally affirming, engineering- and mathematics-based school. The school, which would teach not only Black students but all students, would draw on the culturally relevant pedagogy and would be staffed by Black engineers. Wisdom strongly believes that all students could benefit from an academic environment like the one she envisions.

Wisdom has been able to not only maintain but thrive in a "Black cultural frame of reference" that is said to be consistent with a strong Black identity and the recognition of social inequalities and a differential reward and opportunity.

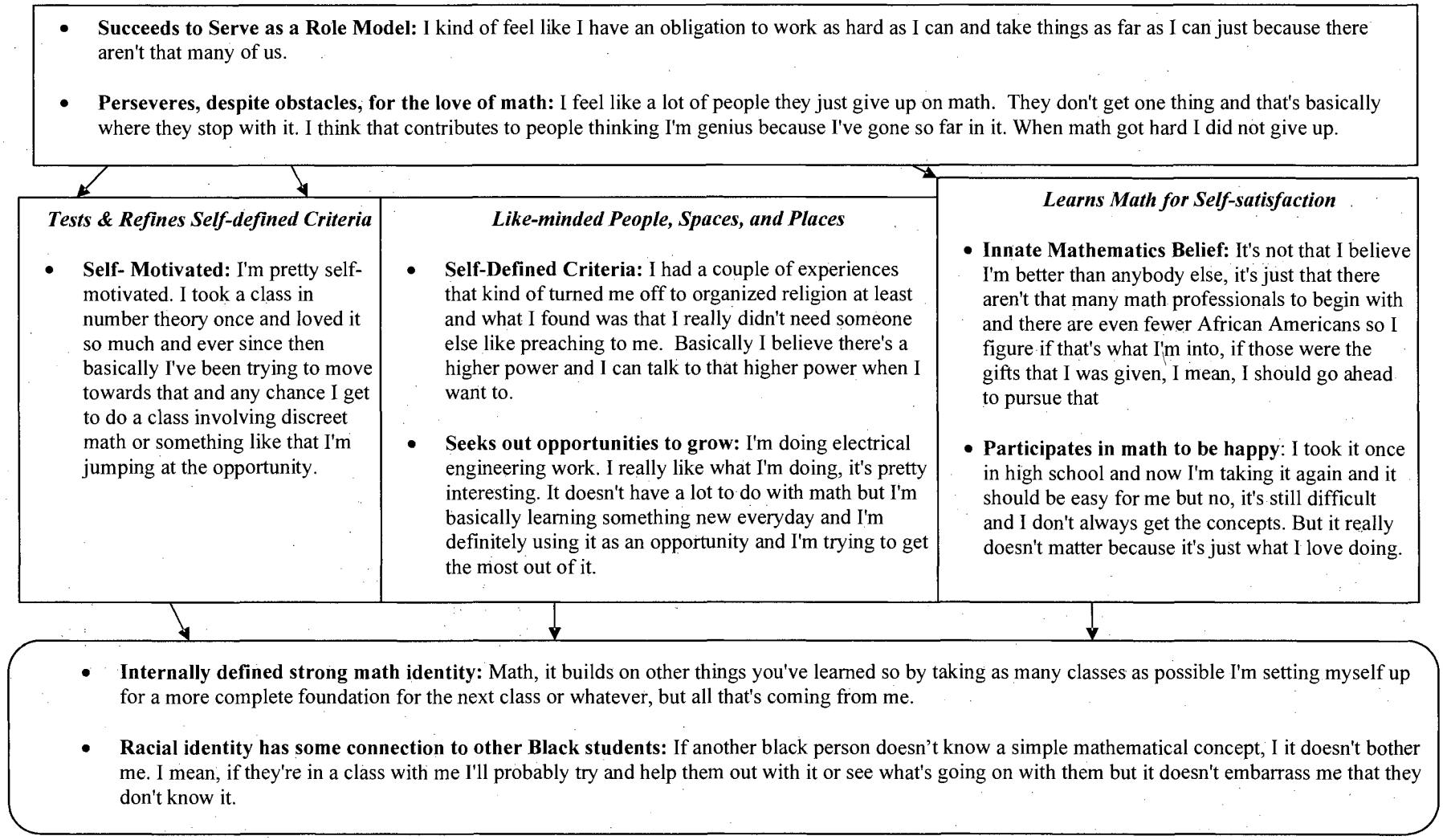
Cory's Life Story

> The negro (sic) makes a thousand fruitless efforts to insinuate himself among men who [are] repulse[d] by him; he conforms to the taste of his oppressors, adopts their opinions, and hopes by imitating them to form a part of their community. Having been told from infancy that his race is naturally inferior to that of whites, he assents to the proposition, and is ashamed of his own nature.
>
> *-de Tocqueville, 1851, p. 358*

In sharp contrast to the histories relayed by Rob and Wisdom, Cory's narrative reflected an acceptance of the ideologies and practices of the dominant society. Cory's parents raised him in a racially isolated environment, and he attended schools that were predominately White. Yet I found Cory to be more complex than the sum of his socialization experiences would suggest. Cory thrived in the traditional educational networks of the cultural mainstream—more particularly, the White, middle-class male student; however, he expressed a drive to achieve because of his responsibility to represent the Black community more equitably. Cory claims colorblindness, yet his social networks overwhelming reflect a White, middle-class male orientation. Mathematics and soccer consume Cory's academic and social lives, respectively; and his mannerisms, dialect, and choice of friendships, music, and clothing style are all attributes that are deemed "normal" within the White culture (See Figure 6.10 and 6.11).



Cory's Fragile Form of Resilience
Figure 6.8



Cory's Robust Form of Resilience
Figure 6.8

Cory readily embraces and complies with the traditional mandates of schooling, even at the risk of being labeled someone who "acts White," and he dismisses the need or responsibility to identify with other Black students simply because he is also Black. Cory resists the temptation to be critical of other Black students who may not be as academically successful as he is, though. On the rare occasion that he shares a class with another Black student, he often serves as a mathematical mentor to him or her. Cory is very humble about his mathematical achievements and considers his success the result of a gift that he was given, which he has an obligation to pursue. Cory is a resilient mathematics learner and enjoys pursuing seemingly impossible mathematics problems. His learning strategy is simple but has proven effective: he keeps working on a problem until he gets it right. His primary goal is to a find a well-paying job that he can enjoy, but he finds value in tutoring mathematics students as well. Although Cory his currently engaged in number theory he jokingly states that he has difficulty with simple mathematical tasks, like calculating a tip or estimating the sales tax on an item

Soho University allowed me to use a room housed within their Multicultural Affairs Office for all my on-campus interviews, and because Cory was my first interview of the dissertation study, I was a bit nervous when I met him. He arrived right on time, wearing a green polo shirt and blue jeans. His complexion was dark, and his features resembled those of my own father who is Nigerian; but I soon found out that Cory and his parents had been born and raised in Chicago. At the time of the first interview, Cory was a second-semester junior.

Cory's Childhood Experiences

Cory described his family life as a stable one founded on mainstream American values (for example, "If you are smart you will succeed."). In Cory's household, academic achievement was

an important determinant in family life, and excelling in education was promoted as the key to lifelong success. Mom, Dad, and two older sisters provided Cory with an early and solid mathematics foundation. Cory's father is an engineer, and Cory's mother is a mathematics teacher who supplemented his mathematics education with several dozen mathematics workbooks "until a math teacher told my mom she needed to stop." Cory remembers his sister—who went on to graduate from Harvard University with an applied mathematics degree and is employed as a market analyst—helping him with mathematics and science homework when they were young.

Cory's early academic experiences involved a transfer in the third grade from a local school in the city where he lived to a suburban school for gifted students. Cory described this school as "excellent" because it accommodated three different levels of mathematics instruction in each grade. His mother's knowledge of the educational system played an important role in deciding where and how Cory would be schooled; and like the parents of some of the other students in this study, Cory's mother advocated for her son to attend a more challenging school even though it meant long commutes into the suburbs.

Cory felt that he was "naturally" able to pick up mathematics concepts quickly. He also developed his own strategies in mathematical problem-solving, which he referred to as "short cuts," because they allowed him to solve mathematics problems quickly and more efficiently. As he advanced to higher-level mathematical concepts, however, some of those "short cuts" failed, and his mother had to reteach him certain concepts using traditional methods.

In the mathematics and science academy that Cory attended for high school, his talent in math flourished. For most of his high school career he attended three-student mathematics classes in which he was the only Black student. But although Cory was enrolled in one of his

city's top schools for gifted students, he often struggled to survive on the bottom-ranked teams at highly competitive state mathematics competitions.

Even with his parents' savvy for selecting the top schools in the city and nearby suburbs, the mathematics education that Cory received paled in comparison to what the other, predominately White mathematics teams around the state enjoyed. When I asked Cory why the mathematics players from outside his city were all on teams A and B (the top two teams), he explained that their success was the result of natural ability and longer experience in mathematics. He said not a word regarding the differential mathematical learning experiences of students in urban and non-urban environments.

Cory's College Experiences

As one of the few Blacks attending his post-secondary institution, Cory goes well beyond complying with the dominant and mainstream rules—he embraces them as good practices to live by and mirrors the behaviors of the dominant group in formal and informal speech, academic interactions, educational aspirations, and social tastes.

In college Cory first took up mechanical engineering because he enjoyed working with his hands; but in engineering the mathematics requirements went only as far as trigonometrics, and he ran out of the mathematics electives he would have needed to pursue additional mathematics coursework. In his sophomore year Cory dove headfirst into a new major—mathematics—once he realized that he was more interested in abstract mathematical concepts than the physical aspects of engineering. Soho University's renowned engineering programs educate over 1,000 engineering students in a given academic year, whereas the mathematics department stands at merely one-twentieth that size with approximately forty to fifty students.

Despite the heavy emphasis on engineering at his school, Cory's love for mathematics and his strong mathematics identity helped him make the switch to his new major:

> I loved mathematics. It's what I do. Basically, of all the different classes I've taken, the only ones I've enjoyed going to are the math classes. I mean, I just enjoy learning new things and new concepts, the way numbers work with each other—it just interests me. I don't really have to—it's almost—it's still work, but if I had to choose between doing homework in any other class, I mean, I'm gonna do the math because I enjoy it. P:[00:32:48.06]

Cory benefited from positive reinforcement through his schooling, and his few negative experiences (for example, being on the lowest-ranked team in high school mathematics competitions) did not appear to diminish his overall belief in his mathematics abilities. His mathematics activities increased in breadth and frequency, as did his success in building his knowledge of mathematics:

> I'm in a number theory class and number theory is my favorite topic of math; and there's a lot of stuff I don't understand in it. It's probably one of the hardest classes I've ever been in. I took it once in high school, and now I'm taking it again; and it should be easy for me, but, no, it's still difficult, and I don't always get the concepts. But it really doesn't matter because it's just what I love doing. So, yeah, when I don't get something in number theory, it doesn't even bother me. I just keep working at it; I just keep trying. Now, in certain other subjects, like probability or statistics, when I don't get something, I just get frustrated, or I just give up because I don't like doing it. 2P:[00:09:05.22]

Cory remains undaunted by the difficultly of his number theory class; and, while he loves abstract and discrete mathematics, he also takes other mathematics classes because he is determined to secure a complete foundation in mathematics. Cory does not have highly sophisticated study strategies: he crams for tests but rarely pulls all-nighters; sometimes he has to stare at a problem for two hours before he tries to tackle it; and he mostly studies alone.

Cory's Racial Identity

Cory racial centrality is in the bottom 20 percent of all interviewees at 3.88 out of 6.00, meaning that race in not a central part of his identity, but ironically he has a very high private regard score of 6.83 out of 7.00, indicating that he feels positively toward the Black community and to a certain extent defines his racial group membership. His centrality score is considerably lower than the other students in this study, with is consistent with his acceptance of colorblind ideology and situated by his feelings of belongingness in a predominately White fraternity.

MIBI (Scale: 1 to 7)	
Centrality	3.88
Private Regard	6.83
Public Regard	3.00

Cory's private regard scores showed that to a very high extent he feels positively toward Blacks. In general, high private regard enhanced positive and reduced negative psychological well-being in Black students. Since, racial centrality was found to be a moderator of private regard and psychological well-being; it appears that his protects his identity by ignoring race. I speculate that Cory would respond to off-color jokes about the Obama presidency that suggest the White House would become "more ghetto" with "barbecues on the front lawn" as innocent banter between the guys.

Yet, his public regard score of 3.00 is an indication that he realizes others in this society practice and believes in racial discrimination and does feel the "stereotype threat" inside many mathematics classrooms. These results may also specify Cory's divergence from the MIBI's results that might require more analysis.

Cory is not bicultural and cannot seamlessly move back and forth between his predominately White world and the more illusive Black world; he appears to be more comfortable operating within the dominant mainstream culture and associating with the architects of that culture. Cory's *MIBI* results demonstrate that he is fine with being Black, all while mainly associating with White people, places, and spaces.

Cory has had very little opportunity to develop relationships with other Black people outside his immediate family. Cory remembers having "only a few" Black friends throughout his life. Although he went to a high school that at the time was 30 percent Black, his honors and AP classes kept him isolated from the Black school population. Cory spent a large amount of time ("24/7" by his account) with his high school mathematics club, where he was the only Black student "consistently" in the group.

Cory recalled not being cognizant of the fact that he was one of only a few Blacks at his elementary school and high school and denied experiencing discrimination or racism in his elementary school years. Later in the interview, though, he shifted his position, declaring that, if there were instances of racism, he "didn't care because [he] was good in mathematics, so nobody was going to get to [him]." When I questioned Cory about experiences of not being treated fairly in his classes by either his teachers or peers, Cory did remember a couple of instances in which he felt that he was treated unfairly; but, although Cory felt that he deserved better grades in those instances, he rejected the notion that the discrepancy had anything to do with his race.

Cory admits to being accused of "acting White a lot." Although Cory dismisses these actualizations as "silly," I believe he wrestles with the perceived unfairness of his nonconformity to an idealized Black cultural norm:

> I guess when I was younger it bothered me. I guess I reached a point where I understood that you're gonna be what you're gonna be and all you can do is be you, so [the idea of] "acting White," "acting Black" is just kind of silly. P:[00:13:14.26]

Campus engagement is closely related to feeling a part of the campus community and may also serve as a mediator between past and future academic self-concept and achievement. Tinto (1993) suggests that students of color may be more likely than their White peers to struggle with social integration. In Cory's case, he is engaged in campus activities mostly through his fraternity. That Cory's fraternity is predominately White appears to serve as a buffer for his social integration issues as an Black student. Although Cory notes that students of color have relatively fewer options for campus activities—and thus socialization (Tinto, 1993)—Cory seemed to diminish the impact of isolation and lack of social engagement by joining a fraternity that mirrors the racial demographics on Soho's campus. Although, Cory describes himself as "colorblind," when he begins to describe the fraternity this colorblindness disappears:

> I'm actually in a fraternity, and the makeup of the fraternity is 90 percent White and 10 percent other. Of course, I'm in that 10 percent and, um, I don't know, we don't even think about it. So, the people I hang out with, it's not actually racially diverse, but it's not something that bothers us because, like I said, we don't even see it. P:[00:17:35.20]

Although Soho University does not have any Black fraternities on campus, Cory contended that if a Black fraternity were on his campus he would still have "considered anybody. It was just basically whoever wanted me." All of his friends hail from the fraternity, which he describes as "an island." While Cory might claim not to see race, his White fraternity brothers certainly see race in very stereotypical ways:

> They [White fraternity members] crack Black jokes sometimes, and I just kind of look at them funny. About Black people stealing, shooting, smelling bad, you know, the stereotypical stuff, and sometimes it gets a little bit annoying, and, you know, I'm just like, "Yeah, okay," but, I mean, they don't do it all the time. It's not a regular thing. But they kind of figure I'm a brother, and at the same time it is a fraternity; it's a bunch of

guys; we give each other a hard time. It is still part of the camaraderie; that's basically what guys do. P:[00:34:29.06]

Cory's strategy of ignoring race, thereby ignoring racism and other forms of racial oppression, helps to protect his ideology of colorblindness. Cory argues that race is an irrelevant category, yet to think that ignoring racism will eliminate racism is naive at best. Pretending that racism is over is the driving force behind racist policies and practices in educational institutions and in society (Cazanave & Neubeck, 2001). On the surface it appears that Cory has developed a raceless persona (Fordham, 1988), indicating a "lack of identification with, or a strong relationship to, the Black community." (p. 58). As Fordham contends:

> [W]ithin the school structure, Black adolescents consciously and unconsciously sense that they have to give up aspects of their identities and of their indigenous cultural system in order to achieve success as defined in dominant-group terms; their resulting social selves are embodied in the notion of racelessness. (p. 82)

Cory insisted that race is not something that the fraternity thinks about or cares about. That fact the he "hangs out" with peers who do not look like him does not bother Cory because, he explains, he does not really see race. Cory did not suggest that he wanted to or conspired to divorce himself from the larger Black community; instead it appears that he was given too few opportunities to connect with the Blacks community and may be socialized to not seek out those relationships. Despite his limited contact with other Black youth, however, there are reflections within Cory's interview that line up directly with the values of the Black community.

I conclude that Cory's contradictory racial attitudes are the result of conscious and unconscious attitudes operating for the acceptance of the dominant society, which is a form of self-hatred. I do realize that the concept of self-hatred has been completely overused, particularly in the 1970s and 1980s to frame most Blacks, but I do believe in this particular case that the concept is valid. Although Cory does not appear to possess anti-Black sentiments, his

refusal to see color, reveals much more than it hides; as he continues to be infected by racism, he continues to deny its affliction. His White fraternity brothers treat Cory in ways that leave him severely excluded, despite his attempts to assimilate seamlessly into the White culture. Cory's Blackness constitutes formidable exclusion variables that make it hard for me to believe that he is not afflicted by psychological or social damage.

Cory's Racialized Mathematics Experiences

Cory acknowledged that he enjoys proving his value in his mathematics classes specifically within the context of his Black identity:

> Ebony: So you mentioned in your first interview that some students might be thinking, "Who's that Black kid in the back of the class?" How does that make you feel?
>
> Cory: It's definitely been a driving force of mine because I get a certain amount of satisfaction sometimes being the only African American in the class because inside my own head—I don't even know if there's people in the class that think like this—but, inside my own head, I figure that there are people like, "Who's the Black kid at the back of the class? What's he doing here? He doesn't belong here," and, like I said, it drives me forward knowing that there are people out there that think like that and I get to prove them all wrong. I think it's motivation for me to do better. I mean, when I walk into a class, I'm like, "Oh yeah, okay, now I get to prove something to these people." I mean, basically it's the motivation to myself. So, like I said, even if they don't say it, I'm still thinking it to myself. I'm probably a competitive person, and that is definitely motivating; it's a huge motivator to me—someone thinking that I can't do something—so I wanna go out there and prove them wrong.

Cory responded to suggestions or thoughts of racism and racial discrimination by working to "prove them all wrong." Edwards and Polite's (1992) study revealed that many successful Blacks have been and remain very aware of the necessity of proving themselves qualified. As demonstrated in the dialogue above, Cory, like many others within the Black culture, has responded to racism and discrimination in ways that have promoted educational attainment

and academic excellence. Additionally, Cory expressed an obligation to "work as hard as he can" in order to be recognized for his achievement within the context of being a Black in mathematics.

Cory's Future Aspirations

Cory possesses a strong achievement orientation that is well aligned with the Black struggle for equality in educational opportunity, educational attainment, and educational success. When I questioned Cory about the lack of Blacks in mathematics, his explanation focused on the lack of financial prosperity a mathematics career entails. Additionally, Cory spoke of the limited career options for mathematics degree holders; he anticipated that he would end up working in education or as a government actuary. Cory identified the most difficult part of becoming a degreed mathematician to be job placement:

> I feel it's because it's not really a career choice that makes a lot of money. And it's something that I had to struggle with when I made the switch from engineering, because I came to Soho University doing mechanical engineering and my thought was, "Well, four years from now I'm guaranteed to have a job, and I'm pretty much guaranteed to have a starting salary between thirty and fifty thousand dollars a year." That's, like I said, that's pretty much guaranteed as an engineer. But then when I made the switch to math, it actually took me awhile because I had to keep thinking to myself, "What am I going to do when I graduate?" ...[B]ut I love math so much I didn't even care. Actually, I asked an actual math teacher before I made the switch what he thought about doing an applied math major and his response to me was "I hope you like math." [I said,] "Yeah, I do," [and he said,] "No, I hope you like math a lot." [*laughs*] I understood what he meant, and I had to make that decision that I may not know where I'm gonna end up when I'm done with this but this is what I love to do. 2P: [00:03:20.11]

Cory's love of mathematics, particularly number theory, outweighed his concerns about job placement.

Cory planned to continue his mathematics education by enrolling in graduate school upon completion of his undergraduate program and after earning his master's degree will then go on

to work as a research and development analyst. Cory's dream career is a job in cryptography, which he described as very high level "puzzle-solving."

Even with his impressive skill level in mathematics, Cory still worried about whether he is on par with the other mathematics scholars currently thriving in the field.

> I'm taking all my classes, fulfilling all my requirements, but at the same time I feel like the level of mathematics in the real world is so far out there. Um, I'm kind of thinking, "Wow, how am I gonna catch up with that?" because, I mean, the breakthroughs and stuff like that, these papers that come out, like, new to the field of mathematics, I'll look at them, and I won't even be able to get past the first page. So I'm constantly thinking to myself, "Well, how much more math do I need to know before I understand what's going on in this paper?" And that's what I'm going to be competing with when I graduate. So when you ask will I be prepared, I mean, yes, I guess I'm about as prepared as I can be, but I don't know; I'm still concerned about it. 2P:[00:38:41.09]

There are so many more theorems, and algorithms, and theories Cory would have to master to be considered an expert in mathematics. That fact the he is more knowledge in mathematics than 95% of all college students does not comfortable Cory, who is comparing his knowledge to that of his professors.

Conclusion

Cory, Wisdom and Rob challenged mainstream cultural norms of academic success. Wisdom and Rob achieved, academically and socially, while maintaining their collective Black identity, while Cory embraced the mainstream ideology for his personal and academic success. Wisdom and Rob use their knowledge of the dominant cultural capital in co-construction of their own Black capital to create a better teaching environment for the next generation of Black mathematicians and engineers. Cory uses his dominant cultural capital without the co-construction of Black cultural capital because he believes the dominant capital is in line with his identity as a colorless man. For Rob and Wisdom their Black cultural knowledge has proven

useful within their academic navigation strategies, despite society's failure to recognize its value, particularly in promoting academic success. Their awareness of racism and prejudice has become both a reason for these African American students to excel as well as preparation in the fight against these evils (King 1993, Sanders 1997). Cory too, expresses an awareness of racism and discrimination and as a result uses that threat as motivation to succeed.

For Wisdom and Rob experiencing racism actually helped them interpret the salience of racialized factors in the work of achieving in mathematics. Cory did not provide any instances where he personally experienced racism, although I pointed out that his fraternity brothers joked about him being a "lazy nigger" more than qualified; he refused to implicate racism into the equation. Wisdom's and Rob's critical narratives, conveyed just how profoundly race shapes social opportunity and mobility in the United States, while Cory's narrative found complex ways to ignore racism, even while minimizing its existence.

All three students, Cory, Rob, and Wisdom see themselves as change agents, expressing strong personal agency and keen teacher identities; an inherent desire to promote and nurture African American youths' agency to develop mathematics intellect. Wisdom and Rob have defined academic and mathematics "success" in ways that affirm their academic achievement without compromising their identification with their culture. Cory certainly is proud to be Black, does not hold hostility toward other Black people, yet he chooses to live his life by identifying with mainstream cultural competencies.

The three students differed in terms of their recognition of race, and in two cases class, operated to constrain their mathematics and engineering accomplishments, they all appear to have succeeded by being true to themselves, and offer diverse strategies by which they interpreted and responded to their subjugation.

CHAPTER 7

NEXT STEPS AND CONCLUSION

Democracy died saved in the hearts of Black folk.

– W.E.B. DuBois

The preceding two chapters provided in depth analysis of the data in order to address the four specific questions that guide this research. This chapter summarizes the main themes from the results and discusses their implications. In this chapter, I review the three foci of the study, identity (racial, mathematical, and otherwise), resilience, and racialized forms of experience, separately. I conclude with some implications and future directions as a result of this study's findings.

The first question that initially guided my dissertation study, *what strategies do high-achieving Black college students use to demonstrate their resilience in mathematics and engineering?*, was dependent upon the time period and level of development in the students' lives. Earlier schooling experiences were dominated by attempting to erase negative based stereotypes about Blacks in general and Blacks achieving in mathematics in particular. I referenced this period of the students' academic career as a fragile form of resilience. During the periods of late high school and early college, most of the students developed more sophisticated self-determined strategies to succeed in mathematics and engineering. The respondents' focus was not just on personal contentment and success was not just a personal goal but a sense of responsibility *as Blacks* to help their own. Twenty-two of the twenty-three students incorporated strategies under the robust form of resilience.

The second initial question of the study explored the personal meanings the students assign to their resilience and success in college mathematics and engineering. Their success varied between two overarching meanings dependent on the form of resilience the students were engaged in. Success in the fragile form of resilience was viewed as a way out of current hardships, financial mobility, and a way to prove themselves to a society that devalues their mathematics and engineering capacity. Success in the robust form of resilience had vastly difference meanings. In that form, the students succeeded to inspire current and future generations of Black mathematics and engineering learners, to serve as role models for those populations, and for the love of the discipline.

Similar to the first and second question, the negotiation of what it means to "be Black" in the context of studying mathematics and engineering, the third question, was also situationally and developmentally dependent. Under the fragile form of resilience, "being Black" caused its share of emotional unrest. The respondents adapted strategies to cope with perceptions of mainstream society; standards that Black youth must abide to if they want to be viewed as smart and worthy of a teacher's attention. Although they had perfected these strategies (e.g., acting White, acting Black, adhering to some aspects of the stereotype), feeling the constant obligation to work within externally driven criteria was draining to their psyches and identities.

The fourth question explored Black racial identity and its potential role in the respondents' mathematics and engineering high achievements. The findings suggest that their Black self-concept varied widely, but they were content to ecstatic about being Black. The students expressed a keen awareness of how and why racism works, in particular how it worked in their lives. The strategies the students initiated were often a result of understanding the difference

types of racism (i.e., structural, everyday, institutional), although a smaller subset of students achieved by minimizing or ignoring racism.

The last question was in part answered by the findings above as the students characterized and responded to learning and participation in mathematics and engineering as racialized forms of experience. There was overwhelming recognition of particular negative racial stereotypes that persist about the lack of achievement for Blacks in mathematics and mathematics-related fields. Additionally, students felt the attribution of inferiority, confirmed by overt and covert racist incidents inside their mathematics and engineering classrooms. Individuals responded to the students' mathematics and engineering abilities with two very polarizing notions: either honorary Whites (or special Blacks) or affirmative action cases.

The next section will describe the findings as they relate to identity and identity development processes.

Racial Identity

To understand and improve mathematics and engineering outcomes among Black students it was necessary to consider and integrate a number of complex factors, which were addressed in this study. Understanding the co-construction of identity allowed me to better comprehend the attendant purposes within Black students' learning spaces and world. My research showed that the students' identities overlapped and intersected in academically nurturing ways.

The very sense of having a group identity—of being Black, of being young, of being White—is significantly rooted in the perception that one is under threat because of that identity (Steele, 1997). This sense frequently arose as the respondents' perceived that their identity was undervalued in mathematics and engineering setting.

The students presented a more nuanced conception of the African American student experience that reflected both the strength of racial identity (strong identification with being Black to intermediate identification with being Black) and the *meaning* of the racial identity – that is, what it means to the student to be Black (Nasir, Rosebery, Warren, & Lee, 2006). The data illustrates the students could both embrace a strong Black identity and be successful in mathematics and engineering. Further, findings illustrate that mathematics and engineering achievement was a part of their very definition of being Black. The intricate balance between racial identity and mathematics identity adds a level of nuance to understanding their overall identities.

As the students progressed into the robust form of resilience, their racial identities transformed to being pro-Black and psychologically nurturing. Once these healthy racial identities were established, regardless of the strategies employed (either fragile or robust), racial identity remained robust. In other words, once a healthy racial identity was established, it is considered to be a stable part of the students' overall identities.

The findings for this study suggest that regardless of the students' self-concept, they, for the most part, possessed an awareness of racial discrimination that was central to their experiences. A realistic perspective of how racism and racialized experiences work appeared to diminish the likelihood that these students would develop a negative orientation toward mathematics and engineering achievement.

The respondents demonstrated the ability to cross racial boundaries in navigating their mathematics and engineering achievement. Yet this study problematizes the notion of biculturalism or biculturality. Clark's (1991) bicultural identity model is based on Blacks successfully coping with racism. Clark's claim is that Black adolescents *successfully* cope with

racism, achieve academically, and maintain a strong sense of group identity by the use of a bicultural identity. These scholars maintain that a bicultural identity appears to enable Black adolescents to overcome negative environmental conditions (racism) while surviving in the environment that instigates the hostility. The students practice biculturality, but they find it anything but seamless and satisfying. The majority of the students loathe having to "play the game," through the adoption of "other peoples policies." Many of the students have gone through considerable measures to maintain a pro-Black racial identity and have chosen particular institutions and work spaces where their racial identity can thrive.

The Racial Identity of Students who Were Raised in Predominately Black Neighborhoods

Students who were raised in predominately Black neighborhoods and attended all or mostly Black schools from kindergarten through high school spoke of a sort of *racial shock*, as they experienced overt racism for the first time. Prior to attending college, these students had little contact with White and Black people who held negative racist attitudes towards Blacks or a certain segment of Black people (e.g., *poor ghetto Black folk*). For a majority of this segment of students experiencing overt racism for the first time, their biggest racial threat was Black-on-Black prejudice. It appears that, as part of their racial socialization, "somebody had told [us] that White people were racist" but nobody told them that "Black people could be racist too." Being raised in mostly low SES neighborhoods, they had experienced their share of structural racism (e.g., lack of opportunities for advancement, inadequate living conditions, a preponderance of crime, drugs, and physical abuse, etc.). These students were also used to the type of self-rejection the manifests in "yo mama so Black..." jokes, the prejudice of "good hair" versus "bad hair," the light-skinned versus dark-skinned debate, and other racial prejudices

that are played out in many Black communities. However, they were less prepared for Blacks who did not like their race and did not want to associate with the respondents simply because they were Black or they were "too Black." The students who experienced this Black-on-Black prejudice were in serious jeopardy of leaving their respective universities to escape this new form of racial threat and protect their identities. These students had not developed sophisticated strategies for coping with these new experiences and had to quickly build tools for dealing with racism, whereas the students who lived in racially diverse neighborhoods or attended racially diverse schools had years to develop this same skill set. Therefore, some type of training, particularly for students who are experiencing this kind of racism for the first time, should be initiated prior to college, to lessen the potentially disastrous effects of racism.

Upon entering college, the respondents who hailed from predominately Black neighborhoods were, more often than not, more than a couple of steps behind in terms of their mathematics knowledge. Yet, the confidence they developed as a result of being the top students in their K-12 schools helped them to persevere. The question arises, if Blacks attended a school were "everybody" thought highly of them as students and human beings, could they temporarily sacrifice academic skill development to thrive in a school environment where they were nurtured, loved, appreciated, and respected? The tools needed to build mathematics and engineering skills seem easier to acquire for Black students than an education in which their racial identity was not on trial. Some researchers who have studied resilience in Black students suggest that Black students should attend racially integrated schools to gain mainstream socialization skills (Clark, 1991). However, my study revealed that the respondents who attended Black schools acquired mainstream socialization skills that rivaled the students who attended racially integrated schools. Schools in general, by design, are operated to reward

mainstream academic and social capital. Using Denise's plain language, "You don't have to go to a White school to learn how to act White. They taught that right here [her predominately Black high school]." Additionally, a recent study concluded that the risk associated with attendance at underfunded schools with limited resources does not appear to be associated with students' achievement outcomes (Fitzpatrick, 1997).

Another interesting conclusion of this study is that for the students who attended all or predominately Black schools, that although this segment of students attended what is traditionally defined as low achieving schools, they enjoyed some benefits rarely highlighted in conventional literature. One benefit was being educated in an atmosphere lacking racial stereotyping.

Let me unpack this concept a bit. The students stated that they did have teachers who did not believe in the abilities of most Black students: most Black students except for them. They were the "best students in the worst schools." As a result the students were often given messages that they could escape from their neighborhoods (and never come back) through high achievement. Some of the students, either temporarily or permanently, believed these messages and sought to leave their predominately Black neighborhoods behind in the dust. Those students who left their Black neighborhoods to attend historically White college institutions realized that the "White world" was not much better than the one they were familiar with. As a matter of fact many of these students experienced "new" forms of prejudice and discrimination that they were underprepared for and very different from the rosy ideologies that were feed to them by their high school teachers and administrators. I have yet to see interventions that deal with Black students meeting racism for the "first" time in college and that suggest what could be done to mitigate these experiences.

Problematizing Bicultural Identity

The respondents expressed dissatisfaction over having to reject or compromise certain parts of their selves in order to achieve success, even if they are extremely good at doing it. Some educational theorists articulate that bicultural identities allow high-achieving African American students to maintain a Black identity while engaging in achievement-oriented behaviors (Carter, 2005; Darder, 1995; LaFromboise, Coleman & Gerton, 1993; López & Contreras, 2005). The Black students in my study often found themselves in contexts where there were a large number of low or underachieving Black students (mostly in K-12 contexts) or a large number of high-achieving non-Black students, yet they were able to maintain their own level of academic achievement. Yet in contexts where there were a large number of non-Black students, they felt that they were forced to hyper accentuate certain characteristics that valued by their mostly White teacher and peers. These characteristics were outside of the characteristics that they deemed as part of their identity (e.g., having to exclude a Black peer from an all White study group because their Black friend was a lower achiever, wearing certain clothes to appear less threatening, smiling a lot to appear friendly and approachable, excessive nodding to show that they agree with the teacher and they understand the lesson, not buying a style of car for fear of it being perceived as "too Black," avoiding questions about their families, walking into the first day of class with the math book outside of the book bag so no one would ask "Are you in the right class," etc.). These strategies worked well but they caused mental distress. Students discussed the emotional preparation it took to perform these tasks they deemed necessary to remain successful. Some students as a result of being fed up with "acting White in all White contexts," which they determine is different that acting White in predominately Black contexts, are purposely pursuing employment at mostly Black institutions. Therefore bicultural identity

may not be enough to enable Black students to fend off negative environmental conditions, such as racism, while surviving in the environment that activates the hostility.

Mathematics Identity

The focus on mathematics identity in this study provided greater understanding of how these students view and experience mathematics and engineering learning and participation.

The students' mathematics identity developed a more self guided stimulus to succeed and dismissed as flawed ideologies that characterized them as inferior. Their current mathematics identities are expressed by narrative form of a *negotiated* self, a negotiation that places their own assertions over the external ascriptions of others (Martin, 2000). Although their mathematics identities are always under construction, the students' self-confidence and pride in their mathematical abilities and mathematics pursuits has caused them to be steadfast in maintaining a self-generated mathematics identity.

Most of the students attested to possessing an innate learning ability in mathematics that aided them in times of both difficulty and ease. When mathematics came with ease to the respondents, they attributed it to their natural inclination to catch on to concepts quickly. In times of mathematics difficulty and challenge, the students demonstrated perseverance because, after all, they felt they were intrinsically born to know mathematics and they understood that sometimes it was not going to be a runaway victory. I believe a mathematics identity could certainly be nurtured in any able-bodied individual, the perception that the respondents were bestowed a "gift" appeared to help them sustain their success in times of challenge. If all students felt as though they had this same gift in mathematics, I wonder, would high achievement outcomes become a more likely result?

The students' ability to perform in mathematical contexts was emotionally turbulent in their early years by their preoccupation of racial stereotypes, yet theses same stereotypes helped them to understand the importance of obtaining mathematical knowledge and as a result the students' achieved to prove themselves worthy of learning and participating in mathematics. Therefore racial stereotypes served as both a constraint and opportunity for the students to develop strategies and motivations geared toward developing a strong mathematics identity. Even in the face of teachers and peers who did not believe in their mathematical abilities, they continued to operate to further increase their mathematical achievements. For example, knowing that some people thought the exact opposite – that Blacks are naturally bad at mathematics – provided an increased desire to show and prove high achievement outcomes. Part of the students' mathematics identity included a proactive stance in seeking out additional opportunities to enhance their mathematical skills and knowledge, such as gaining all the necessary skills to compete with the mostly White students at such events as mathematics competitions. Encompassed within their mathematics identities were ideologies about the opportunities structure that exists for their racial group versus the White racial group and strategies to mitigate those inequities.

In the fragile and robust forms of resilience mathematics identity is developed but for whom? (for oneself or for others) is the key differentiator. In the fragile form of resilience the students are achieving to prove others wrong or to make to satisfy the desires of their guardians. The fragile form of resilience proves to a strong enough motivator to sustain mathematics success and mathematics identity development over a considerable period of time. For most of the students, they were able to achieve in mathematics until their high school years by employing externally motivated forces. Their strategies and motivations shifted to more

internal forces (e.g., intrinsic love for mathematics, sense of self-satisfaction that came with doing mathematics), which were also shaped in- part societal forces as well. There appears to be a close connection between mathematics identity development and human development. As these students began to develop and mature, and understand their world (and racism), they began to seek out reasons for learning and succeeding in mathematics and engineering that are linked to their self-interests and collective community interests.

These successful African American mathematics and engineering students indicate that their mathematics identities were in complex competition with racist ideologies, particular within that school system that assesses racial stereotypes over academic ability. The students navigated through the racialized nature of mathematics, which largely taught them that success is achieved by identifying with and emulating White middle class male principles, all while engaging in academic performances that made them high achievers. Most the students in this study presently maintain self-driven mathematics identities, which overlap with their struggles to maintain African American identities. Their mathematics identities are linked to their identities as role models and mentors to the Black community. Many of the students sought desired to teach mathematics and engineering to Black learners to increase their participation in those disciplines, bringing to the learning environment the experience of their own differential treatment in learning mathematics. The results of this study add to an important interpretive framework that unpacks outcomes in mathematics and engineering achievement, persistence, and resilience in Black students (Martin, 2000).

Referring back to the model for trajectories of resilience among successful Black mathematics and engineering students (Figure 4.4), once an internally-driven mathematics identity is developed (found in the robust form of resilience), it cannot be shattered, even by the

usage of temporary strategic actions within the fragile form of resilience. Once students developed internalized motivations for learning, participating and succeeding in mathematics their mathematics identities did not revert to an externally oriented mathematics identity. However, an internally motivated mathematics identity did not always correlate to a career in mathematics or engineering. Having a strong intrinsically motivated mathematics identity was not enough for three of the students to continue in the mathematics or engineering fields. This result denotes the difference between a mathematics identity and a *mathematics career identity.*

Mathematics as Racialized Forms of Experience

Just as long-time civil rights activist and *Algebra Project* founder Bob Moses recently argued that mathematics literacy is the new civil rights issue and the key to the future of disenfranchised communities (Moses & Cobb, 2001), the results show that mathematics and engineering literacy is complicated for Black students by the necessity to defend themselves against racial stereotypes and other racialized experiences.

Smith (2004) in his definition of Racial Battle Fatigue discusses the constant stereotyping that Students of Color face on college campuses and the time and energy these stereotypes entail for those students. My study showed that students experience *mathematics battle fatigue* in two major ways; first through the identification of stereotypes and other forms of racialized discrimination, and second from being exhausted from their initial *stereotype management* strategy of rejecting or attempting to accommodate the stereotypes, which, at best, only offered temporary relief. I am introducing the term *stereotype management* to describe the strategies the students developed and utilized to deal with the strain of being racially stereotyped. Yet, the load of carrying these racial microaggressions, daily hassles, and fears that come from

functioning in racially stressful environments was debilitating emotionally, even while exhibiting mathematics and engineering academic success (Solorzano, Ceja, & Yosso, 2000). Yet, over time and the incorporation of their own unique identities the students developed complex and protective strategies that helped them deal with the burden of being negatively perceived. Their strategies revolved around self-definition, but with the consideration of the collective health and vitality of their communities through mathematics and engineering empowerment.

Resilience

The students in this study demonstrated unyielding courage and determination in the face of great adversity. Their academic achievements are in part the result of protective factors that outweighed or at least balanced the risk. Some of those protective factors included: family support system, being raised in a predominately Black neighborhood, being raised in predominately White neighborhood, placement in temporary foster care, perceptions of innate mathematical abilities, self-affirming racial identity, membership in a predominantly White fraternity, a socially conscious career perspective. Their self-described risk and protective factors demonstrated the tremendous variability that exists from student to student. Also, the respondents' demonstrated that some risk factors can also be protective as well, depending on situation and time period (i.e., living in a predominately Black neighborhood, appearing not visibly Black).

For those Black students who have not been taught mathematics or engineering by a Black teacher or who experience turmoil over the racial stereotypes as they engage in mathematics and engineering learning and participation and, as a result, constantly feel like their intellectual credibility is on trial, I contend that the solution for these students is in securing support for

developing and maintaining their own robust form of resilience. A robust form of resilience can help protect Black students from operating mainly within a fragile form of resilience, to a more self-defined, self-determined identity process.

The findings show that the students' resilience trajectory was a developmental process that occurred over time. I believe that all students are capable of benefiting from a well-developed robust form of resilience. Particularly since 22 of the 23 students incorporated the robust form of resilience into their identity development resulting in high mathematics and engineering achievements. The mathematics and engineering communities may be missing out on a strong cohort of Black mathematics and engineering professionals who possess strong mathematics abilities but do not have the toolkit to grow from fragile into robust forms of resilience. Mathematics educators should capitalize on the potential of these students by assisting them in achieving robust resilience.

Recommendations for Mathematics Teachers and College Support Programs

This exploration into the complexities and challenges teachers face as they attempt to promote mathematics literacy in their Black students enhances the research of emergent mathematics education scholars (Bol & Berry, 2005). For example, Berry (2005) suggested that mathematics teachers should become more critical of their instruction as their current practices may contribute to ineffective instruction for various groups of students. Gutstein (2006b) calls for the promotion a critical mathematics pedagogy that addresses the economic, cultural, and social realities of students of color. Culturally relevant pedagogy connects teachers with their students' cultures and communities, challenges curriculum that hinders student success and

empowerment (Ladson-Billings, 1998; Matthews, 2003, Murrell, 2002; Moses-Snipes & Snipes, 2005; Tate, 1995b, 1995c).

The results of my research suggest that there are no exact prescriptions that would apply for all Black mathematics and engineering students. I propose that there are particular needs for middle and high school Black students that differ from the needs of other students. Although this research does not offer a sole prescription, my model serves as a necessary first step in understanding the complex nature of Black learning experiences in mathematics and engineering. This research raises considerations for educators.

It is quite possible that many years of anti-racist training and development are in order for White teachers to interrogate their Whiteness in order to understand their role in maintaining the stereotypes that are problematic for their Black students. This interrogation is necessary for mathematics education reformers to finally understand, appreciate, and include the racially motivated experiences of Black students, inside and outside the mathematics classroom, in ways that break away from a standard based on White middle-class culture. That way, members of the mathematics and engineering community could fully share in the dutiful responsibility of combating injustice and oppression to produce greater persistence and participation in mathematics for Black students.

Members of these communities who are supportive of Black students striving for full and meaningful participation in mathematics and engineering should be applauded and supported in their efforts. There are mathematics educators who emphasize equitable learning and participation experiences inside the classroom that help foster equity outside the classroom. Although there are multiple conceptions on what mathematical literacy for marginalized communities should look like (e.g., Gutstein, 2006; Martin & McGee, in press; Tate, 1994), most

emergent mathematics educators agree that there is a need to understand how the social construction of race plays out in the mathematics classroom (Martin, in press). Yet critically addressing this complex issue requires empowering Black students to develop their own resilience, not only to increase and expand their career opportunities, but to change the conditions of their lives, and impact the lives of others.

Since we continue as a racist society, mathematics teachers need to be malleable about their internalized beliefs on Black students. Teacher's beliefs, in part, drive achievement expectations and tracking decisions, and play a role in the achievement outcomes and life opportunities of Black students.

Mathematics educators have recently published a number of studies that have examined gender differences in mathematics achievement outcomes (Gallagher & Kaufman, 2005; Lubienski, 2001a; Tate, 1997). For example, a female teacher (White or Black), who is afraid of the Black male students in her class, will mostly likely have an impact on how she engages with these students, her expectations, and her fears, which will ultimately influence the mathematics literacy of the Black male students in her classroom. Likewise, female teachers need to better understand the learned experiences of Black male youth which may cause a non-violent but aggressive Bravado identity (Spencer et al., 2003). A Bravado identity is characterized by a heightened state of readiness seen as necessary to keep the threat inherent in high-risk environments (both perceived and realized) to a minimum. Some Black males identities include a Bravado component to protect their mental and emotional health. Many Black males use this identity to help cope with their challenging neighborhood environments.

The general expectation that males do better in mathematics than females (read Whites males and White females), may not ring true for Black males and Black females engaged in

mathematics learning and participation. The point is, within the context of understanding that gender matters, race continues to play in an integral role in how one's gender is evaluated (Collins, 1990).

Of course, teachers will also need support as they redefine their roles as meaning-makers. Social worker involvement (within and outside the classroom) will aid in understanding the social and emotional support and coping skills that Black students need. Mathematics teachers, as part of their mathematics methodology classes, need to better understand Black identity issues and develop skills to interpret Black behavior. Recognizing and addressing one's own misconceptions and perceptions is an important priority to those who want to support the high achievement of Black students. Educators must recognize and incorporate the voices, experiences, and hopes of Black students without labeling or devaluing them, or requiring them to participate in a normalized failure paradigm. Although introspection, self assessment, and commitment to change is not easy, it is imperative that this becomes a widespread educational initiative if we are to succeed in supporting high mathematics and engineering achievement among all of our students.

Steele (1992) proclaimed that "more than half of black college students fail to complete their degree work—for reasons that have little to do with innate ability or environmental conditioning (p. 68)." College support programs are in a unique position to prepare Black students and their families for the challenges in historically White universities. For example, for those populations of Blacks that have limited exposure to Whites (e.g., Black students that were raised in all Black neighborhoods, attended Black schools, etc.) need training on how to navigate through racism on college campuses. Black students who major in mathematics and engineering should be aware that they may encounter discrimination as a result of stereotypes

about Blacks in mathematics based majors. College support programs that support the needs of Blacks students should be aware of the debilitating effects of discrimination which cause many students to temporarily or permanently drop out of college. College programs could support the needs of Black students, whose school culture often requires them to master the culture and ways of American mainstream culture, encouraging them to submerge their Black culture in that of the majority and give up the particulars of being Black—their styles of speech and appearance, value priorities, preferences. These programs should also partner with Black student organizations (e.g., Greek letter organizations, Black student government, and advocacy groups like NAACP) to provide them an extra layer of support in retaining their student membership. Students who are more socially integrated into the university and still are able to find a sense of identity have access to a key component of college education persistence (Tinto, 1993).

Many campuses host intensive summer bridge programs, for mathematics and engineering majors for high-achieving Black high school students to prepare for the freshman year, where factors like college culture shock, classes designed to "weed-out" those students who are considered less interested or not hard working (read Black), negative stereotypes, low faculty expectations, are commonplace for many Black freshman college students. During this summer program, as teachers provide intense training for academic preparedness, counselors or other college support staff could prepare the students for the mental stresses of *being Black* and high-achieving in mathematics and engineering.

Although many of the students performed well in their mathematics and engineering classes, the students really benefited from applying the skills they learned in class to outside research opportunities. Internships and research assistantships served as an additional source of

support, financially, and validated their ability to apply what they knew in ways that affirmed their sense of identity as mathematics and engineering achievers. College support programs could help to facilitate internship opportunities related the students' field of interest to increase retention in mathematics and engineering.

The Upside of Racial Stereotypes?

Most researchers that study Black students assume that their attitudes and beliefs about the role of race in defining themselves has a significant impact on how they experience schooling (Asante, 1991; Cross, 1991; Phinney & Alipuria, 1990; Sellars et al., 1998a; Steele, 1997, 1999; Woodson, 1990). In the field of mathematics education, there is a great deal of evidence for social, racial, and environmental factors that influence the observed racial differences in performance on standardized mathematics tests (Steele & Aronson, 1995, 1998). According to Steele, this difference is in part due to stereotype threat, which fosters the perception that some racial groups' academic achievements are undervalued in educational settings, particularly mathematics (1997, 1999). Stereotype threat involves "the threat of being viewed through the lens of a negative stereotype or the fear of doing something that would inadvertently confirm that stereotype" (Steele, 1999, p. 46). More technically, in contexts in which racial stereotypes are active, members of the negatively stereotyped groups (e.g., Black students) will be conscious of the content of those stereotypes, and this may negatively affect their performance. In the context of performance on standardized math tests, Black who are currently aware of racial stereotypes related to mathematics ability may experience anxiety related to the confirmation of those stereotypes, and as a result, their performance on math tests will suffer (Steele & Aronson, 1995, 1998).

There is a lot of evidence that stereotype threat can affect intellectual performance (Chavous, Harris, Rivas, Helaire & Green, 2004; Harpalani, 2007; Oyserman, Brickman, & Rhodes, 2007; Taylor & Antony, 2000). Yet, there is less evidence that racial stereotypes can actually serve as a catalyst for mathematics (and engineering) achievement. Steele (1997) does note that Black students can feel that their intelligence and ability is always on trial, even while they are effectively interacting and succeeding across cultures, but he stops short of identifying racial stereotypes as a motivator for some Black students to achieve, particularly in the academically competitive and highly racialized fields of mathematics and engineering. The students in my study posed a novel and interesting perspective on this issue by attempting to defy racial stereotypes through their mathematics achievement. Although they eventually began to incorporate more intrinsic motivations for success, it appears that their coping and identity-related responses presumably helped them to navigate achievement in spite of the stereotypes. Therefore, the use of racial stereotypes may serve as an academic enhancer for some Black students to thrive in mathematics and achieve mathematics excellence, particularly in their K-12 years. Harpalani (2008) has identified the counterstereotypic identity hypothesis as "individuals who defy stereotypes related to their group membership, such as high academic achieving Black students, employ specific beliefs and coping strategies related to the domain in which they defy the stereotype (e.g., intellectual ability), resulting in greater identity salience for that domain" (p. 3). The results of this study indicate that students never really succeeded in defying stereotypes, and as a result of not being able to defy them, they searched for more internal reasons to pursue mathematics and engineering excellence. For these students, race itself, manifested through experiences of stereotypes, served as both a risk and a protective factor, depending on the context, and their racial socialization strategies appeared to offset the

academic effects (but not the mental effects) of racial stereotypes. These findings need to be explored further.

Questions to Guide Future Research

This study focused specifically on successful high-achieving Black college students, students who demonstrated academic and life resilience. The question arises: Which came first the chicken or the egg? More specifically, does resilience help to foster high mathematics and engineering achievement or does high mathematics and engineering achievement help to foster resilience or do they co-exist and, if so, how?

There are Black students who are resilient in dealing with and surmounting non-academic challenges and who yet perform poorly in school mathematics. What are types of resilience possessed by lower achieving mathematics and engineering students that allows them success in meeting life's challenges in general, but not in school? One preliminary speculation is that the lower achieving mathematics and engineering students may be operating within a non-academic form of resilience, and this form of resilience may look different from the fragile form of resilience in my model, which includes the development of a mathematics identity. There may be a way to encourage these lower-achieving students into adopting a form of resilience that includes mathematics and engineering success. Understanding why some students appear to transcend potentially negative environments in ways that promote their success, while others the resist or accommodate their environments in ways that hinder academic success is an important question and one that requires additional research.

Additionally, this study revealed that the production of an externalized mathematics identity (i.e., doing good in mathematics to appease or defy other peoples' expectations) in the

K-12 years that enhanced the agency of Black college students to succeed in mathematics and engineering. Bandura (1997) suggested that individuals exhibit a form of agency that allows them "to behave differently from what environmental forces dictate rather than inevitably yield to them" (p. 7). He further suggested that students' perceptions about their own self-efficacy enable them to build cognitive models that guide their decision-making and learning. The definition of resilience includes the positive capacity of people to cope with stress and hardship. Resilience is also used to indicate a characteristic of a refusal to accept the consequences of negative events. Resilience corresponds to cumulative protective factors and is used in opposition to cumulative risk factors. This study focused on resilience over agency as resilience showcases the ability to succeed in spite of non-cognitive hardships. Both agency and resilience suggest the filtering of the messages in meaningful ways that enables students to develop independent strategies for school success. Future studies should further investigate the role of agency (Martin, 2000) and its relationship to resilience in Black students.

Some scholars argue that due to Black's knowledge of the limited opportunity structure that exists for their group, they possess a more pessimistic attitude about school and, as a result, earn lower grades (Ogbu, 1978; Fordham & Ogbu, 1986). Yet, what is so unique about these students is they, too, in some cases, held very pessimistic attitudes about career possibilities, particularly in the lower paying field of mathematics. The students certainly believed that there would be a positive return on investment in their education, but they rarely expressed attitudes of future upper class grandeur. Many students couched understanding of future employment opportunities within a forecast of race negatively shaping their career opportunity structure. The students in this study spoke of being successful in mathematics and engineering but still not being able to participate equitably as mathematics and engineering professionals, due to the

multitude of racial injustices found within the make-up of these disciplines. To clarify career expectations such as these in relation to their career realities, further research should be performed with Black mathematics and engineering students after college, possibly with mid-career level mathematics and engineering Black individuals.

My study included three non-U.S. born Blacks. About 17.6 percent of all Black adults over the age of 25 in the United States hold at least a four-year college degree compared to 22.6 percent of non-U. S. born Black adults (close to the 30.6% for whites). The three non-U. S. born Blacks revealed more similarities than differences in their college experiences compared to U.S. born Blacks, but there K-12 lives were dramatically different. Although there are nuances in racial identity that may occur for reasons that deal with nationality and culture, the commonalities in their experiences, such as lack of privilege and power, are shared because of the shared meanings for *Blackness* in the U.S. society. Yet, after listening to the narratives of all 23 students, I am still left wondering, how is it that these two geographically different groups of Blacks share such similarities in their college experiences and their perceptions of what is means to be Black in America?

A few of the students in this study expressed conflict and antagonism toward mathematics and their school environment and they resisted the schools' authority and ideology. To clarify, the majority of the students followed the rules and regulations set by school administrators, teachers, and other school personnel. Yet, they expressed a great deal of resentment over some of the school policies and rejected them, even if only in their minds. This resistance offers a more socially and historically relevant account of nonconformity, even while enduring the rules and while maintaining mathematics and engineering achievements. Solórzano (2001) argues, "resistance theories demonstrate how individuals negotiate and struggle with structures and

create meanings of their own from these interactions" (p. 315). He refers to resistance as how one reacts to social injustice and forms their own opinions about these conditions. A more thorough investigation of resistance theory would be useful to further understand how Black students experience and struggle against the current social structure with high achievement outcomes. Resistance theory might also be useful in comprehending the Black family's and community's non-traditional efforts to self-educate, despite enduring obstacles (Perry, 2003). Although most of the students in this study recognize that society is structured in a way that benefits the "oppressor," they did not feel completely disempowered, and through resistance, sought to become change agents by becoming mentors in mathematics and engineering. The respondents' dedication to providing more opportunities for Black students to learn and engage in mathematical knowledge is inextricably related to the participants becoming resistance educators. This political act could be unpacked through the investigation of progressive Black mathematics teachers who teach to overcome issues of lack of access to knowledge, and racial, class, and gendered oppression through mathematics literacy.

The early school experiences of the participants in this study were dominated by a fragile resilience trajectory. During their elementary and high school years the main motivation to achieve was couched in proving their mathematical abilities to others, thereby verifying that they are worthy of being educated. Did operating within a fragile form of resilience help them to develop a high-awareness of racism and racial discrimination? In other words, is a fragile trajectory a necessary step toward developing knowledge of external forces that could have otherwise served as education catastrophes? Speculating on Black students that dropped out of mathematics and engineering (particularly those one with a strong mathematics identity), they most likely were not able to develop past the fragile form of resilience. Of the 23 students in

this study only one student was able to succeed operating under the fragile form of resilience and even he intends to shift out of the engineering field for his career. This leaves me wondering if Black students, who could have navigated the academic terrain, might have aborted their majors because of lack of know how in developing a more intrinsically guided mathematics identity and positive Black identity. These are all questions that emanate from this research that I hope to develop further.

This study attempts to fit critical analysis of Black experience into mathematics and engineering education. This research is corrective as it has illuminated distortions that exist in mathematics and engineering education literature. It is descriptive as it offers past, present, and anticipated future constitutions of the Black experience, constructively analyzed. It is prescriptive in that these students provided a fresh narrative and new possibilities for the mathematics and engineering education community as a whole. It is exploratory because it focuses on new and under-explored research areas (i.e., resiliency as it relates to high-achieving Black mathematics and engineering college students). It is explanatory because it focuses on the "why" by exploring the reasons these students are successful from their rich co-constructed perspectives. The results of this research will aid in eroding the top-down, White masculine hierarchy prevalent in research of high-achieving mathematics and engineering students.

The research presented in this study provides mathematics and engineering researchers and educators with additional conceptual tools that are useful in understanding the complexities of high-achieving Black students and their mathematics and engineering lives. This research is fueled by a longtime interest in how Black students achieve and sustain success in the racially stereotyped and competitive field of mathematics.

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APPENDICES

APPENDIX A

Medium University

Yearly Enrollments	# of Black Engineering Enrollment	Total Engineering Enrollment	% of Black Students
Fall 2004 – Sum 2005	227	3391	6.97%
Fall 2005 – Sum 2006	248	3332	7.49%
Fall 2006 – Sum 2007	475	6723	7.99%

Table VIII
Medium's College Engineering Undergraduate Fall Enrollment

Yearly Graduation Rates	# of Black Engineering Graduates	Total Engineering Graduates	% of Black Graduates
Fall 2004 – Sum 2005	25	368	10.16%
Fall 2005 – Sum 2006	22	343	6.57%

Table IX
Medium's College Engineering Undergraduate Degree Recipients

Soho Institute

Year	Black	White	Hispanic	Alien	Asian	Nat. Am.	Other	Male	Female	Total
2007	31	560	70	219	174	7	86	910	237	**1147**
2006	39	541	61	182	170	4	87	877	207	**1084**
2005	47	453	65	185	145	4	86	789	196	**985**
2004	46	450	60	183	130	2	67	763	175	**938**
2003	40	437	67	175	129	3	68	729	190	**919**

Table X
Soho's Undergraduate Engineering Fall Enrollment

APPENDIX A (continued)

Year	Black	White	Hispanic	Alien	Asian	Nat. Am.	Other	Male	Female	Total
2007	11	100	15	50	36	1	16	179	50	**229**
2006	7	95	7	46	24	0	10	155	34	**189**
2005	9	94	12	58	25	0	6	170	34	**204**
2004	4	108	14	54	30	1	1	160	52	**212**
2003	11	96	15	47	31	5	2	172	35	**207**

Table XI
Soho's Undergraduate Engineering Degrees Conferred

Year	Black	White	Hispanic	Alien	Asian	Nat. Am.	Other	Male	Female	Total
2007	14	153	10	610	40	0	21	677	171	**848**
2006	20	170	12	604	46	0	23	695	180	**875**
2005	17	172	18	551	39	1	14	665	147	**812**
2004	8	146	13	510	26	1	6	570	140	**710**
2003	8	159	6	482	41	0	8	574	130	**704**

Table XII
Soho's Masters Engineering Fall Enrollment

Year	Black	White	Hispanic	Alien	Asian	Nat. Am.	Other	Male	Female	Total
2007	3	35	3	214	11	0	5	223	48	**271**
2006	2	56	5	206	8	1	2	233	47	**280**
2005	3	37	5	215	12	0	5	217	60	**277**
2004	2	45	2	216	19	0	3	235	52	**287**
2003	7	52	4	151	10	0	3	198	29	**227**

Table XIII
Soho's Masters Engineering Degrees Conferred

APPENDIX A (continued)

Year	Black	White	Hispanic	Alien	Asian	Nat. Am.	Other	Male	Female	Total
2007	3	40	2	181	6	0	3	193	42	235
2006	2	38	5	161	8	0	2	175	41	216
2005	3	25	4	152	6	0	1	146	45	191
2004	1	28	3	168	10	0	1	169	42	211
2003	0	25	1	168	11	0	2	169	38	207

Table XIV
Soho's Doctoral Fall Enrollment Engineering

Year	Black	White	Hispanic	Alien	Asian	Nat. Am.	Other	Male	Female	Total
2007	0	4	1	27	2	0	0	25	9	34
2006	0	1	0	24	1	0	0	21	5	26
2005	0	3	0	30	2	0	0	33	2	35
2004	0	3	0	23	2	0	0	24	4	28
2003	0	4	1	15	0	0	1	15	6	21

Table XV
Soho's Doctoral Engineering Degrees Conferred

Browning College

Year	Black	White	Hispanic	Alien	Asian	Nat. Am.	Other	Male	Female	Total
2007	40	2	5	0	1	0	5	27	26	53
2006	38	3	9	0	1	0	2	31	22	53
2005	55	5	9	0	0	0	1	36	34	70
2004	63	6	5	1	0	0	1	45	31	76
2003	67	5	6	0	1	0	0	39	40	79

Table XVI
Browning's Mathematics Undergraduate Fall Enrollment

APPENDIX A (continued)

Year	Black	White	Hispanic	Alien	Asian	Nat. Am.	Other	Male	Female	Total
2007	9	1	5	0	0	0	0	8	7	**15**
2006	17	3	1	0	0	0	0	14	7	**21**
2005	12	2	1	0	0	0	0	8	7	**15**
2004	3	0	0	0	0	0	0	2	1	**3**
2003	3	2	0	0	0	0	1	2	4	**6**

Table XVII
Browning's Mathematics Undergraduate Degrees Conferred

Year	Black	White	Hispanic	Alien	Asian	Nat. Am.	Other	Male	Female	Total
2007	12	2	2	0	2	1	0	8	11	**19**
2006	13	2	0	0	2	1	1	12	7	**19**
2005	18	4	1	0	2	0	0	14	11	**25**
2004	15	4	0	0	2	0	0	9	12	**21**
2003	22	5	1	0	1	0	1	15	15	**30**

Table XVIII
Browning's Mathematics Master's Program Fall Enrollment

Year	Black	White	Hispanic	Alien	Asian	Nat. Am.	Other	Male	Female	Total
2007	6	2	1	0	1	0	0	8	2	**10**
2006	6	1	0	0	1	0	0	3	5	**8**
2005	2	1	0	0	0	0	0	2	1	**3**
2004	8	3	0	0	1	0	2	11	3	**14**
2003	3	1	0	0	3	0	0	6	1	**7**

Table XIX
Browning's College Mathematics Master's Degrees Conferred

APPENDIX A (continued)

As the statistics indicate over the recent years (2003 - 2007) Browning has went from graduating less than five percent of their African American mathematics students, on the undergraduate and level, to graduating 45% of enrollees in 2006 and 22.5% of enrollees in 2007, on average. Similarly for Browning's master's degree enrollees in 2006 and 2007 Browning graduated 50% of their enrollees, on average.

Year	Black	White	Hispanic	Alien	Asian	Nat. Am.	Other	Male	Female	Total
2007	43	731	65	146	279	0	60	940	384	**1324**
2006	44	726	59	154	280	1	58	959	363	**1322**
2005	43	673	54	163	283	0	59	923	352	**1275**
2004	50	643	53	162	267	1	64	906	334	**1240**
2003	49	666	56	168	275	2	68	916	368	**1284**

Table XX
Ivy University's Engineering Fall Enrollment

Year	Black	White	Hispanic	Alien	Asian	Nat. Am.	Other	Male	Female	Total
2007	9	156	5	52	59	0	16	225	72	**297**
2006	6	136	14	46	87	0	13	205	97	**302**
2005	12	147	14	43	59	0	11	211	75	**286**
2004	12	183	12	43	62	0	17	236	93	**329**
2003	21	152	14	24	80	1	17	206	103	**309**

Table XXI
Ivy University's Engineering Degrees Conferred

APPENDIX A (continued)

Ivy's Bachelor's of Science Degrees are disproportionate in a number of ways: 2 to 1 males to females are awarded degrees; approximately a 15 to 1 ratio of Whites to Blacks awarded undergraduate engineering degrees.

	2003 - 2004	2004 - 2005	2005 - 2006	2006 - 2007
# of Black Graduate Engineering Students	9	14	17	15
Total # of Graduate Engineering Students	584	710	636	536
% of Black Graduate Engineering Students	1.54 %	1.97 %	2.67%	2.80%
Total Number of Black Engineering Master's Degree Recipients	2	5	2	2
Total Number of Black Engineering PhD Degree Recipients	1	1	2	1
# of Black Graduate Mathematics Students	0	0	1	1
Total # of Graduate Mathematics Students	37	45	46	42
Total # of Black Math Master's or PhD recipients	0	0	0	0

Table XXII
Ivy University's Graduate Level Engineering and Mathematics Statistics

APPENDIX B

Informed Consent Document to Participate in Dissertation Study:

Race, Identity, and Resilience: Black College Students Negotiating Success in Mathematics and Engineering

Dear Prospective Research Participant:

My name is Ebony McGee. I am a Doctoral Candidate in the College of Education at the University of Illinois at Chicago. I am currently in the recruiting stage of my dissertation research. The title of my dissertation study is *Race, Identity, and Resilience: Black College Students Negotiating Success in Mathematics and Engineering.* My dissertation advisor is Dr. Danny Martin, Associate Professor in the College of Education at the University of Illinois at Chicago. This dissertation study is being funded by the Spencer Foundation and the ASHE/Lumina Foundation.

The objective of this study is to better understand how a select group of African American mathematics and engineering college students develop and maintain high achievement outcomes. Specifically, the goal is to better understand how these African American students interpret and frame their academic achievement within educational arenas where African American presence is scarce. I would like you to take part in this research study by agreeing to participate in the questionnaire and survey.

SURVEY

I will be asking you to complete a survey. The demographic questionnaire will include things like your gender, ethnicity, career aspirations, etc. and will take approximately 5 minutes to complete. In addition, I will ask you to complete a survey to better understand your experiences as a Black mathematics and engineering student. This survey will take approximately 10 minutes to complete.

INTERVIEW

To capture the thoughts, feelings, and expression of African American junior, senior and graduate mathematics and engineering students I will also be interviewing selected students who participate in the above survey.

If you are selected to be interviewed, the interview will take place in a mutually agreed upon location at a time that is convenient for you. All interviews in this study are audiotaped and participants have the option of being videotaped, which will typically take one and one-half to two hours. However, this may vary depending on your individual responses to the interview questions. I will ask both general and specific questions about you and your early schooling history and overall life experiences as well as your experiences with mathematics and engineering learning and participation in and out of school. If it is determined that additional information regarding these experiences is needed, I will request the opportunity for a second interview or a short follow-up discussion. If necessary, this second interview will also be audio recorded with the optional of being video-recorded.

To capture the living essence of the conversation and to provide a powerful counterstory against the myriad of negative images on African Americans and mathematics and engineering achievement, I will ask you to give permission to videotape the interview. The video recording of the interview is optional and will in no way effect your participation in the study. If you agree to being videotaped and become uncomfortable with any portion of the interview or recording, you are free to stop the recording at any time.

SUPPORTING DOCUMENTS

Supporting documents such as old report cards, transcripts, teacher evaluations, or other school records may also be requested, either at the time of the interview, or as a follow up. Provision of such documents is, however, voluntary. I will either (a) make photocopies of original documents and return originals to you in person or (b) copy needed information from these documents into your coded record at the time of the interview.

CONFIDENTIALITY

All of the information that I obtain during the interview will be kept confidential. Neither you nor anyone else referred to in your interview will be identified by name or any other identifiable characteristics. I will use a code that conceals your, and others', identity in all interview data and supporting documents so that only me and my dissertation advisor will be able to determine your identity. All identifying information (names, addresses, school name, etc.) on supporting documents provided to us will be blacked out and given pseudonyms when needed for presentation purposes. I will store and lock the interview tapes, supporting documents, and notes from the research in a secure location in my home office. I will use excerpts of the interview tapes and supporting documents for my dissertation. I will also use excerpts in published research reports that explain any important findings from this study. Your confidentiality will be maintained in these discussions and reports. I will keep the tapes, supporting documents, and notes for a period of approximately five years after the duration of this study. When they are no longer useful, I will erase the tapes and shred the notes and supporting documents.

The questions that we will ask you during the interview are not expected to be upsetting; however, please remember that you can skip any questions that you are not comfortable asking. You may withdraw at any time should you feel uncomfortable. While you will not directly benefit from participation in this research, you may be helping educators better understand the factors that influence mathematics learning and participation among African Americans. I am confident that this project will add to the understanding of the achievements of African American mathematics and engineering students.

If you would like to participate or have questions about the research, please call me, Ebony McGee, at 773.603.8980(cell). You can also contact me by email at emcgee2@uic.edu. After receiving your verbal consent to participate, I will provide you with a copy of this *Informed Consent Document* as well as a *Consent Form to Participate in Dissertation Research Study* for your records.

If you have any questions about your rights as a research subject, may call the University of Illinois at Chicago Office for the Protection of Research Subjects at 312-996-1711.

Ebony McGee
Doctoral Candidate, University of Illinois at Chicago

Consent Form to Participate in Research Study:

Race, Identity, and Resilience: Black College Students Negotiating Success in Mathematics and Engineering

The study described above has been explained to me by Ebony McGee and I voluntarily agree to participate and be interviewed if selected.

I have read (or someone has read to me) the above information. I have been given an opportunity to ask questions and my questions have been answered to my satisfaction. I agree to participate in this research. I have been given a copy of this form.

Print Name _____

Signature _____

Email Address (Optional): _____

Phone # (Optional): _____

I give permission to videotape me while I am in this study:

Please initial: _____ Yes _____ No

I do not give permission to videotape me while I am in this study:

Please initial: _____ Yes _____ No

APPENDIX C

Telephone Script

Explanation and Invitation to Participate in Dissertation Study entitled-- Race, Identity, and Resilience: Black College Students Negotiating Success in Mathematics and Engineering

Thank you very much for inquiring about this study to better understand the experiences of African American mathematics and engineering college students. I would like you to read the following script describing the study, its purposes, procedures, and potential risks.

Dear Prospective Research Participant:

This dissertation study currently entitled Race, Identity, and Resilience: Black College Students Negotiating Success in Mathematics and Engineering is being conducted by Ebony McGee, Doctoral Candidate in the College of Education at the University of Illinois at Chicago. This dissertation study is being funded by the Spencer Foundation and the ASHE/Lumina Foundation.

This dissertation study seeks to better understand how a select group of African American mathematics and engineering college students develop and maintain achievement outcomes.

I would like you to take part in this research study by agreeing to participate in the questionnaire and survey. I will be asking you to complete a questionnaire and perform a brief survey. The questionnaire will include things like your gender, ethnicity, career aspirations, etc. and will take approximately 5 minutes to complete. In addition, I will ask you to complete a survey to better understand your experiences as a Black mathematics and engineering student. This survey will take approximately 15 minutes to complete.

To better understand their beliefs and experiences and their relationship to mathematics learning and participation, I will also be interviewing African American junior, senior and graduate mathematics and engineering students. If selected, I would like you to take part in this research study by agreeing to be interviewed.

Should you consent to the interview, it will take place in a mutually agreed upon location at a time that is convenient for you. All interviews in this study are audiotaped, and participants have the option of being videotaped, and typically take one and one-half to two hours. However, this may vary depending on your individual responses to the interview questions. I will ask both general and specific questions about you, your schooling history, overall life experiences as well as your experiences with mathematics learning and participation in and out of school. If it is determined that additional information regarding these experiences is needed, I will request the opportunity for a second interview or a short follow-up discussion. If necessary, this second interview will also be recorded, with the optional of being video-recorded.

To capture the living essence of the conversation and to provide a powerful counterstory against the myriad of negative images on Blacks and mathematics and engineering achievement, I will ask you to give permission to videotape the interview. The video recording of the interview is optional and will in no way effect your participation in the study. If you agree to being videotaped and become uncomfortable with any portion of the interview or recording, you are free to stop the recording at any time.

Supporting documents such as old report cards, teacher evaluations, or other school records may also be requested, either at the time of the interview, or as a follow up. Provision of such documents is, however, voluntary. I will either (a) make photocopies of original documents and return originals to you in person or (b) copy needed information from these documents into your coded record at the time of the interview.

All of the information that we obtain during the interview will be kept confidential. Neither you nor anyone else referred to in your interview will be identified by name. I will use a code that conceals your, and others', identity in all interview data and supporting documents. Only I and my graduate advisor, Dr. Danny Martin, will be able to determine your identity. All identifying information (names, addresses, school name, etc.) on supporting documents provided to us will be blacked out and given pseudonyms when needed for presentation purposes. I will store and lock the interview tapes, supporting documents, and notes from the research in a secure location in my graduate advisor's school office. I will use excerpts of the interview tapes and supporting documents for my dissertation study. I will also use excerpts in published research reports that explain any important findings from this study. Your confidentiality will be maintained in these discussions and reports. I will keep the tapes, supporting documents, and notes for a period of approximately five years after the duration of this study. When they are no longer useful, I will erase the tapes and shred the notes and supporting documents.

The questions that we will ask you during the interview are not expected to be upsetting; however, please remember that you can skip any questions that you are not comfortable asking. You may withdraw at any time should you feel uncomfortable. While you will not directly benefit from participation in this research, you may be helping educators better understand the factors that influence mathematics learning and participation among African Americans. I am confident that this project will add to the understanding of the achievements of African American mathematics and engineering students.

After receiving your consent to participate, I will provide you with a copy of an Informed Consent Document to Participate in Dissertation Study for your records.

Please feel free to write down one of the contact methods to contact me, Ebony McGee. Cell phone: 773.603.8980. email: emcgee2@uic.edu

Thank you. Please advise me on your interest and feel free to forward this message to any other mathematics or engineering student which might be interested. Also the flyer is attached for your convenience.

Very Best,
Ebony

APPENDIX D

Student Demographic Questionnaire

Race, Identity, and Resilience: Black College Students Negotiating Success in Mathematics and Engineering

Please complete the following information by either checking (□) or filling in the necessary information. Please write eligibly.

BACKGROUND DEMOGRAPHICS

Gender: _____Male _____Female

Race (check all that apply): _____Black _____ African American

Please list your ethnicity (ie. Jamaican, Nigerian, etc): _____

Age: _____ **Birthdate:** _____

Were you raised in a one parent/guardian or two parent/guardian household? _____

By Whom? (Mother, Father, Grandma, etc.) _____

Do you speak another language other than English? _____ Yes _____ No

What language? _____

Primary Language spoken at home _____

Your Parent(s)/Guardian(s) Average Annual Household Income:

_____Less than $20,000 _____$60,000 – $79,999

_____$20,000 – $39,999 _____$80,000 – $99,999

_____$40,000 – $59,999 _____Over $100,000

Birthplace of Parents/Guardians (list City/State or Country if not U.S.)

_____

How long have you been living in the U.S.? _____

Number of Siblings in the household? _____

HIGH SCHOOL OR GED EDUCATION

When did you graduate from High School (Approximate Date)? _____

-OR- GED received date _____

Name, City and State of High School: _____

High School GPA: _____

Did you take AP Exams in High School? _____Yes _____ No

If so please list the Classes and the fail/pass grade or score (be sure to include mathematics classes, if applicable):

Exam Name	Score (Pass/Fail)
_____	_____
_____	_____
_____	_____
_____	_____

Did you start a career/job before entering college? _____Yes _____No

If so what was the career/job? _____

UNDERGRADUATE COLLEGE DEMOGRAPHICS –List your undergraduate information *ONLY*

Specific name of current Mathematics or Engineering Major (ie. Applied Mathematics or Electrical Engineering): _____

List minor (if applicable): _____

Enrolled in college part-time or full time?: _____Part-time _____ Full-time

Current GPA and Anticipated Graduation Date: _____

Do you have a part-time of full time job: _____Part-time _____ Full-time

How many hours/week do you work? _____

Please list the job title: _____

How many years have you been in College: _____

Major Entering in College: _____

Do you anticipate going to Graduate School? _____Yes _____No

--If so for what discipline/major? _____

What is your intended career? _____

------UNDERGRDUATE STUDENTS STOP HERE. ***Thank you for your participation.*****-------**

GRADUATE STUDENTS DEMOGRAPHICS –Graduate Students Only Complete this Section

What institution did you receive your undergraduate degree:

_____

Name of your undergraduate degree and GPA:

_____

What year did you receive your undergraduate degree?: _____

What degree(s) are you currently seeking (ie. MS, PhD, etc)?: _____

Specific name of current Mathematics or Engineering Degree (ie. Applied Mathematics or Electrical Engineering): _____

Specific Area of Concentration: _____

Anticipated Graduation Date: _____

APPENDIX D (continued)

Do you have a part-time or full time job: _____Part-time _____ Full-time

Do you have a research or teaching assistantship? _____

If so please specify: _____

What career are you aspiring towards attaining? _____

APPENDIX E

Multidimensional Inventory of Black Identity (MIBI) Scale

	Strongly Disagree			Neutral			Strongly Agree
1. Overall, being Black has very little to do with how I feel about myself.	1	2	3	4	5	6	7
2. It is important for Black people to surround their children with Black art, music and literature.	1	2	3	4	5	6	7
3. Black people should not marry interracially.	1	2	3	4	5	6	7
4. I feel good about Black people.	1	2	3	4	5	6	7
5. Overall, Blacks are considered good by others.	1	2	3	4	5	6	7
6. In general, being Black is an important part of my self-image.	1	2	3	4	5	6	7
7. I am happy that I am Black.	1	2	3	4	5	6	7
8. I feel that Blacks have made major accomplishments and advancements.	1	2	3	4	5	6	7
9. My destiny is tied to the destiny of other Black people.	1	2	3	4	5	6	7
10. Blacks who espouse separatism are as racist as White people who also espouse separatism.	1	2	3	4	5	6	7
11. Blacks would be better off if they adopted Afrocentric values.	1	2	3	4	5	6	7
12. Black students are better off going to schools that are controlled and organized by Blacks.	1	2	3	4	5	6	7
13. Being Black is unimportant to my sense of what kind of person I am.	1	2	3	4	5	6	7
14. Black people must organize themselves into a separate Black political force.	1	2	3	4	5	6	7
15. In general, others respect Black people.	1	2	3	4	5	6	7
16. Whenever possible, Blacks should buy from other Black businesses.	1	2	3	4	5	6	7

Appendix E (continued)

	Strongly Disagree			Neutral			Strongly Agree
17. Most people consider Blacks, on the average, to be more ineffective than other racial groups.	1	2	3	4	5	6	7
18. A sign of progress is that Blacks are in the mainstream of America more than ever before.	1	2	3	4	5	6	7
19. I have a strong sense of belonging to Black people.	1	2	3	4	5	6	7
20. The same forces which have led to the oppression of Blacks have also led to the oppression of other groups.	1	2	3	4	5	6	7
21. A thorough knowledge of Black history is very important for Blacks today.	1	2	3	4	5	6	7
22. Blacks and Whites can never live in true harmony because of racial differences.	1	2	3	4	5	6	7
23. Black values should not be inconsistent with human values.	1	2	3	4	5	6	7
24. I often regret that I am Black.	1	2	3	4	5	6	7
25. White people can never be trusted where Blacks are concerned.	1	2	3	4	5	6	7
26. Blacks should have the choice to marry interracially.	1	2	3	4	5	6	7
27. Blacks and Whites have more commonalties than differences.	1	2	3	4	5	6	7
28. Black people should not consider race when buying art or selecting a book to read.	1	2	3	4	5	6	7
29. Blacks would be better off if they were more concerned with the problems facing all people than just focusing on Black issues.	1	2	3	4	5	6	7
30. Being an individual is more important than identifying oneself as Black.	1	2	3	4	5	6	7
31. We are all children of a higher being, therefore, we should love people of all races.	1	2	3	4	5	6	7

Appendix E (continued)

	Strongly Disagree			Neutral			Strongly Agree
32. Blacks should judge Whites as individuals and not as members of the White race.	1	2	3	4	5	6	7
33. I have a strong attachment to other Black people.	1	2	3	4	5	6	7
34. The struggle for Black liberation in America should be closely related to the struggle of other oppressed groups.	1	2	3	4	5	6	7
35. People regardless of their race have strengths and limitations.	1	2	3	4	5	6	7
36. Blacks should learn about the oppression of other groups.	1	2	3	4	5	6	7
37. Because America is predominantly white, it is important that Blacks go to White schools so that they can gain experience interacting with Whites.	1	2	3	4	5	6	7
38. Black people should treat other oppressed people as allies.	1	2	3	4	5	6	7
39. Blacks should strive to be full members of the American political system.	1	2	3	4	5	6	7
40. Blacks should try to work within the system to achieve their political and economic goals.	1	2	3	4	5	6	7
41. Blacks should strive to integrate all institutions which are segregated.	1	2	3	4	5	6	7
42. The racism Blacks have experienced is similar to that of other minority groups.	1	2	3	4	5	6	7
43. Blacks should feel free to interact socially with White people.	1	2	3	4	5	6	7
44. Blacks should view themselves as being Americans first and foremost.	1	2	3	4	5	6	7
45. There are other people who experience racial injustice and indignities similar to Black Americans.	1	2	3	4	5	6	7

Appendix E (continued)

	Strongly Disagree			Neutral			Strongly Agree
46. The plight of Blacks in America will improve only when Blacks are in important positions within the system.	1	2	3	4	5	6	7
47. Blacks will be more successful in achieving their goals if they form coalitions with other oppressed groups.	1	2	3	4	5	6	7
48. Being Black is an important reflection of who I am.	1	2	3	4	5	6	7
49. Blacks should try to become friends with people from other oppressed groups.	1	2	3	4	5	6	7
50. The dominant society devalues anything not White male oriented.	1	2	3	4	5	6	7
51. Being Black is not a major factor in my social relationships.	1	2	3	4	5	6	7
52. Blacks are not respected by the broader society.	1	2	3	4	5	6	7
53. In general, other groups view Blacks in a positive manner.	1	2	3	4	5	6	7
54. I am proud to be Black.	1	2	3	4	5	6	7
55. I feel that the Black community has made valuable contributions to this society.	1	2	3	4	5	6	7
56. Society views Black people as an asset.	1	2	3	4	5	6	7

VITA

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Phone: 773.603.8980

Education

Ph.D.	Mathematics Education, 2009 University of Illinois at Chicago (UIC) Thesis title: *Race, Identity, and Resilience: Black College Students Negotiating Success in Mathematics and Engineering* Dissertation Committee: Dr. Danny Martin (Chair), Dr. Eric Gutstein, Dr. Amanda Lewis, Dr. Celina Sima, and Dr. David Stovall
M.S.	Industrial Engineering, 1998 New Jersey Institute of Technology (summa cum laude)
B.S.	Electrical Engineering, 1995 North Carolina Agricultural & Technical State University (summa cum laude)

Awards and Grants

Nov 2008	Keynote Speaker for the 2008 Success Summit, African American Success Foundation. *Resilience among Successful African American Mathematics and Engineering College Students.* Fort Lauderdale, Florida.
2005	Exemplary Graduate Mentor Award for Undergraduate Research and Leadership Activities, Institute for Research on Race and Public Policy, University of Illinois at Chicago.
2004 - 2005	Lydia Donaldson Tutt-Jones Memorial Research Grant, African American Success Foundation, Ft. Lauderdale, Florida.
1997-1998	Graduate Representative of the Year, Graduate College, New Jersey Institute of Technology, Newark, New Jersey.
1996	Ralph Ward Achievement Award for highest graduating GPA of nation wide graduating Jackie Robinson Scholarship recipients, Jackie Robinson Foundation, New York.

Fellowships & Scholarships

2007-2008	Abraham Lincoln Fellowship, University of Illinois at Chicago
2007-2008	Jackie Robinson Foundation "Extra Innings" Graduate Fellowship
2006-2007	Spencer Dissertation for Research Related to Education Fellow
2006-2007	Association for the Study of Higher Education/Lumina Foundation Dissertation Fellow
2006	American Educational Research Association Minority Fellow Finalist (unable to accept)
2006	American Psychological Association Doctoral Research Seminar Fellow
2005-2006	Dr. Martin Luther King Scholarship, Graduate College, UIC
2003-2006	Diversifying Faculty in Illinois Fellowship
1996-1998	Fellowships for Graduate Minorities in Engineering and Science (GEM)
1991-1996	Jackie Robinson Foundation National Scholarship funded by General Electric
1991 -1996	General Motors Scholarship
1991-1993	Roothberth Fund National Fellowship
1991-1992	Alpha Kappa Alpha National Scholarship

Referred Articles and Book Chapters

McGee, E. (in-press). When it comes to the mathematical experiences of African Americans…Race Matters. To appear in *Negro Educational Review.*

Martin, D. & McGee, E. (2009). Mathematics literacy for liberation: Knowledge construction in African American context. To appear in B. Greer, S. Mukhophadhay, S. Nelson-Barber, & A. Powell (Eds.), *Culturally responsive mathematics education.* Mahwah, NJ: Lawrence Erblaum Associates.

McGee, E. (Under review). Protective factors that help African American mathematics and engineering college students succeed. Submitted to the *Journal of Research in Mathematics Education.*

McGee, E. (2005). *Chronicles of Success: Black Students Achieving in Mathematics, Science and Engineering*, 2005 Success Summit of the African American Success Foundation, Fort Lauderdale, FL. Published online: http://www.blacksuccessfoundation.org/

Research Projects

Summer 2008 Research Assistant, Women in Science and Engineering, UIC

- Co-Principal Investigator for a study on Women college students who transfer out and immigrate into science, technology, engineering and mathematics majors

2005-2006 Principal Investigator. *When it comes to the Mathematical Experiences of African Americans and Latinos…Race Matters,* Chicago State University, IL

- Sole researcher for qualitative research project dedicated to understanding the mathematical experiences of Chicago State University students through a series of narrative papers and focus groups with the intent to improve the mathematical literacy of these students.

2004-2005 Principal Investigator, Dissertation Pilot Study
Funded by African American Success Foundation, Ft. Lauderdale, FL

- Investigation of 9 academically high achieving Black college students majoring in mathematics and engineering

Teaching and Business Experience

2008-Present Teaching Assistant, Introduction to African American Studies, UIC

- Developed curriculum and taught weekly discussion lectures for two African American studies class. Lessons created focused on the history of and theoretical perspectives within Black Studies; African American historiography and research methods; and issues of race, class, gender, and social identity in the African American experience from philosophical and theoretical perspectives.

2006 – 2007 Mathematics Lecturer, Chicago State University

- Provided qualitative and quantitative tools as an emerging strategy to teach a mathematics methods course

2005- 2006 Mathematics Specialist, African American Academic Network, University of Illinois at Chicago

- Developed curriculum and taught introductory to Algebra course to conditionally admitted incoming African American freshman undergraduate students
- Grant writer for the development of an comprehensive mathematics

program incorporating critical thinking skills and culturally relevant mathematics curriculum

2005- 2006 Graduate Assistant, Chancellors Committee of the Status of Blacks, University of Illinois at Chicago

- Facilitated various activities and projects relating to campus governance, employment practices, public relations, student affairs and a number of others that directly affect the well being of Blacks on the UIC campus and surrounding community.

- Co-founded a campus-wide Black and Latino/a graduate organization

Summer 2005 Coordinator Undergraduate Research Forum: Promoting Success Among African American and Latina/o College Students. University of Illinois, Chicago

- Worked with UIC faculty, post-doctorates, graduate students, academic support services and representatives of UIC policy based programmatic units to produce a forum for 100 incoming undergraduates to highlight the pivotal role of incorporating research experiences and leadership opportunities into their college career.

2004- 2005 Mathematics Lecturer, Harold Washington College, City Colleges of Chicago

2003- 2005 Mathematics Lecturer, Kennedy-King College, City Colleges of Chicago, IL

Fall 2003 Educational Psychology Lecturer, University of Illinois, Chicago

1997-2002 Competitive Intelligence Analyst, Hewlett-Packard – Test & Measurement Division, Rockaway, NJ

Non-Print Media Invited Presentations

McGee, E. (February, 2007). *The Black Relationship GAP.* Panel Discussion Speaker for Chicago Tonight, WTTW's Channel 11 Public Television Station, Chicago, IL.

McGee, E. (February, 2007). *I am Technology: The State of Blacks in Higher Education.* Panel Speaker presented at the Illinois Institute of Technology, Chicago, IL.

Peer Reviewed National Conference Presentations and Papers

McGee, E. (April, 2009). *Moving Beyond the "Gap-Gazing" Fetish: Exploring Mathematics Learning and Participation as Racialized Forms of Experience.* Paper to be presented

at the American Education Research Association Annual Conference: Disciplined Inquiry: Education Research in the Circle of Knowledge, San Diego, CA.

McGee, E. (April, 2009). *Meaning-making, human development and resilience: A new direction in mathematics education.* Paper to be presented at 2009 National Council of Teachers of Mathematics Annual Meeting & Exposition: Equity: All Means ALL, Washington, D.C.

McGee, E. (November, 2008). *Resilience among Successful African American Mathematics and Engineering College Students.* Paper presented at the Benjamin Banneker Association's 2008 Conference on the Mathematics Teaching, Learning, and Research of African American Students, Little Rock, Arkansas.

McGee, E. (May, 2008). *Race, Identity, and Resilience: Black College Students Negotiating Success in Mathematics and Engineering: Preliminary Results.* Paper presented at 2nd Annual Critical Race Studies in Education Conference: Towards a Critical Race Praxis in Education and Social Life, Chicago, IL.

McGee, E. (March, 2008). *Interrogating stereotypes, institutional racism, and racialized experiences in mathematics education.* Paper presented at the 2008 American Educational Research Association Annual Conference, Chicago, IL.

McGee, E. (March, 2008). *Writing the mathematics classroom: Using African American college students written words to understand their mathematical experiences.* Paper presented at the 2008 Race in the Writing Center: Towards New Theory and Praxis Annual Conference, Chicago, IL.

McGee, E. (April, 2007). *Racialized Mathematical Experiences of Black College Students.* Paper presented at the 2007 African American and Latino Dialogue and Research Forum: Building a Community of Scholars, Chicago, IL.

McGee, E. (April, 2007). *When it comes to the Mathematical Experiences of Black and Latino College Students...Race Matters.* Paper presented at the annual meeting of American Educational Research Association, Chicago, IL.

McGee, E. (January, 2007). *Mathematics Education and the Black Student: Exploring Critical Theories of Race.* Paper presented at the 2007 4th International Conference on Teacher Education and Social Justice, Chicago, IL.

McGee, E. (2006). *Black Academic Success in College.* Paper presented at the 2006 Eyes on the Mosaic Conference-Race-ing the Academy Conference, University of Illinois, Chicago.

McGee, E. (2006). *Exploring Critical Theories of Race in Mathematics Education.* Paper presented at the annual meeting of the National Council of Teachers of Mathematics. St. Louis, Missouri.

McGee, E. (2006). *Mathematically Talented African American College Students- Counter-narratives of Success.* Paper presented at the 1st Annual Education and the Public Good: Interdisciplinary Trends in Graduate Scholarship conference. Chicago, IL.

McGee, E. (2005). *Does Mathematics Success = Equity for High Achieving African American Students?* Paper presented at the Mathematics Colloquium on Diversity, Departments of Mathematics and Computer Science at Chicago State University, Chicago, IL.

McGee, E. (2005). *Social Identities of African American College Students in the Context of Mathematical Achievement.* Paper presented at The Ninth Annual Graduate and Professional Research Conference at Northwestern University: Many Minds, Many Voices, Shaping One Legacy, Evanston, IL.

McGee, E. (2005). *Afrocentric Identity as a Precursor to Understanding the Mathematical Success in African American College Students.* Paper presented at the annual meeting of American Educational Research Association Annual Meeting, Montreal, Canada.

McGee, E. (2005). *W.E.B. DuBois' Double Consciousness Revisited in the Context of Mathematical Achievement.* Paper presented at The 7th Annual Chicago Ethnography Conference: "Broadening the Scope of Ethnography" Chicago, IL.

McGee, E. (2005). *Self-Determination as Pathways to Mediating Mathematics Success in African American High School Students.* National Multicultural Conference and Summit, Hollywood, CA.

McGee, E. (2004). *The Problem of African American Education in the 21st Century.* Paper presented at the 27th Annual Olive-Harvey College Black Studies Conference, Chicago, IL.

National Service

2007-2008	Proposal Reviewer, 2008 Annual Association for the Study of Higher Education
2007	Discussant, American Educational Research Association, Chicago, Illinois
2006-Present	Grant Writer, Athletes Committed to Education. Chicago, Illinois
2003-Present	Founder and President, The Relationship G.A.P. (Growing As People). Chicago, IL
2000- Present	Nominated as Chicago Scholarship Selection Committee Member for the National Jackie Robinson Foundation Scholarship, New York, New York
1996-Present	Delta Sigma Theta Sorority Incorporated: A National Public Service Organization, Chicago, Illinois

2005	Ad-hoc reviewer, *Equity & Excellence in Education.* University of Massachusetts

University Service

2007-Present	The Dissertation Associates Working Group of the Institute for Research on Race and Public Policy, UIC
2005	Graduate Assistant, Chancellors Committee of the Status of Blacks, UIC
2005-Present	Founding Member, Alliance for Latino and Black Graduate Students, UIC
1997	Omicron Delta Kappa, National Leadership Honor Society
1997	Alpha Epsilon Lambda, Graduate Academic Excellence and Leadership Honor Society
1994	Tau Beta Pi, National Engineering Honor Society
1993	Society of Women Engineers

Active Professional Memberships

American Educational Research Association

Jackie Robinson Foundation Alumni

National Council of Teachers of Mathematics

Teachers for Social Justice

Society for the Psychological Study of Social Issues

Chicago Alumni Chapter of North Carolina A&T State University

Omicron Delta Kappa, National Leadership Honor Society

Alpha Epsilon Lambda, Graduate Academic Excellence and Leadership Honor Society

Tau Beta Pi, National Engineering Honor Society

References

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60607Email:dostoval@uic.edu Phone: (312) 413-5014 Fax: (312) 413-8134

Subject: Permission to use the dual axis version of PVEST...Re: My model of resilience
From: "Margaret Beale Spencer" <marges@gse.upenn.edu>
Date: Wed, December 10, 2008 5:16 pm
To: "McGee, Ebony O" <emcgee2@uic.edu>
Priority: High
Options: Report As Spam | View Full Header | View Printable Version | Download this as a file

Hi Ebony,
You have permission to use my Dual Axis version of PVEST which includes the resilience outcome option. My only request is that you indicate the appropriate citation (i.e., Spencer 2006). I believe you have the referencing information (i.e., Handbook of Child Psychology). If not, please note the following (i.e., see insert below). Take care and warm regards, mbs

p.s. I am VERY sorry that it is not possible to attend your defense, however... I know you will do a great job!!

Spencer, M. B. (2006). Phenomenology and Ecological Systems Theory: Development of Diverse Groups In W. Damon and R. Lerner (Eds.), (6th Edition) Handbook of Child Psychology, vol. 1, (Chap. 15, Theory Volume) (pp. 829-893). New York: Wiley Publishers.

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----- Original Message -----
From: "McGee, Ebony O" <emcgee2@uic.edu>
To: <marges@gse.upenn.edu>
Sent: Monday, November 17, 2008 6:12 PM
Subject: My model of resilience